CHEMICAL & METALLURGICAL ENGINEERING

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As They Do It In Scotland

THE GLASGOW meeting of the Society of Chemical Industry, which is reported elsewhere in our columns, indicates that they are keeping chemistry alive in Great Britain. Compared with the meetings of the American Chemical Society its purpose is clearly more social and less devoted to the presentation of papers. Thus, in a meeting which lasted a week, the only papers were the address of the president, the Messel medal address, one on the calibration of storage tanks, one on the viscosity of cellulose in cuprammonium hydroxide, and four papers under the general heading of evaporation and distillation given under the auspices of the chemical engineering group. The fact is, the purpose of the meeting is not for members to read papers to one another; it is rather to see things and to talk informally.

Indeed, at the meetings of the chemical engineering group, which is a very lively section of the society, the authors of the papers do not read them. They are printed in full and distributed. The authors talk about their papers and answer questions which are launched from the floor in great profusion. The chairman is selected with great care as one familiar with the subject under discussion and acquainted with those who have addressed themselves to its problems. There were three members of the American Section of the Society (i.e., the Section in the United States, and not including the five Canadian branches), Messrs. J. V. N. DORR, HENRY WIGGLESWORTH and our consulting editor, ELLWOOD HENDRICK. We gather that from the tales these gentlemen are likely to bring home other cis-Atlantic members will make a point of attending British meetings in the future.

The welcome provided by the City of Glasgow was made an event of such distinction and grace as to be long remembered by those who were present.

Success at $2.50 Per Year

"BECOME an executive! Don't envy the man behind the mahogany desk, get there yourself."

We could go on quoting advertisements in almost any magazine in the United States, the very number of which is evidence of the success of the ventures which they are promoting. Some magazines devote themselves almost exclusively to stories as to how JOHN SMITH, hardware manufacturer, or furniture dealer, or city editor, became a success—or how he thinks he became a success. There is danger in all of this, danger that men will believe success is due to some trick system or catch phrase. The influence of these things upon the community is unbalancing. It leads inevitably to a superficial view of success. It conceals the cardinal fact that success in any field is the result of work and intelligent study.

How many times have you heard a young man say, "I believe that I have executive ability, and I want to become an executive. I don't want to waste my time in a minor capacity." Right here is the real tragedy of this philosophy of success. JOHN SMITH, carpet manufacturer, may like to believe that his success was due to the advice given him by a friend of his young manhood, who said "Never weaken," or some equally inspiring thing. But JOHN SMITH'S success has behind it 30 years of work, of intelligent concentration, of detail, and those things are not emphasized or even mentioned. All this tempts the younger generation to believe that if only someone says to them "Never weaken," then they are fated for certain success at an early age.

What young Americans need, and this applies to young technical men as much as to any other group, is a task master and whip. Perhaps someone can suggest another antidote for the insidious poison that success is to be obtained by cutting magazine advertisement coupons, or by subscribing to a course of reading, or by reading a particular magazine, or by following a given catch phrase. The task master and the whip have produced results in the past. Something must make men realize that intelligent study and hard work are the sure roads to success and make them abandon their gods of clay which produce nothing but swollen vanity and baseless self-confidence.

The Portland Cement Industry And Its Association

TRADE associations have been very much in the limelight recently, partly because the Attorney-General of the United States has suspected them of violating the Sherman act; partly because Mr. HOOVER has done his best to find out from the Attorney-General what a trade association should do and what it should not do; and partly because of the vast and increasing number of trade associations in existence at the present time in the United States. The Portland Cement Association is one of the largest in the country and the methods by which it works as well as the aims toward which it is working are interesting. In this issue we are publishing an account of the association and its work. The article is instructive from another point of view in that it represents all that is now safe for a trade association to undertake. You can be assured that with the federal investigation searchlight turned on trade associations none of them is going to undertake anything that is not perfectly conservative. Particularly is this true of the Cement Association, whose members are under federal indictment at the present time for conspiracy on price fixing.

From the chemical engineering point of view there are other phases of this question of portland cement

which are disquieting. The Portland Cement Association has sponsored and carried out a good piece of work in standardizing the specifications of portland cement. It, however, has not standardized portland cement. Some grades are very much better than others. All of them pass the requirements of the standard specifications, but some of them just barely pass it, and others pass it by a very wide margin. It is therefore inevitable that within a short time there will be a grading of cement. The cement industry does not welcome this, as it will complicate sales and manufacturing, but there is a strong demand for it by many prominent civil engineers. Some of the more progressive cement manufacturers favor it, realizing that their own particular product is far better than the average on the market.

Again, there is another phase of the question which is closely associated with the grading of cement. We have reference to the bettering of portland cement as a product. Very little work is being done on that at the present time. The Portland Cement Association is confining itself to the education of the public in the use of its present product and claims that there is no use in manufacturing a better grade of cement until the public knows how to use the present grade. There is something in this, of course, but no industry can be regarded as healthy which disregards completely the work of improving its product. What is the portland cement industry going to do about it?

Finally, there is a strong disbelief on the part of many that the Cement Association is teaching the public how to make better concrete. Invariably every improvement in concrete making which is announced indicates the desirability of using more cement. After a certain time this becomes monotonous and then suspicious. If there be truth in this belief, then the cement industry would better beware. You can't fool all of the people all of the time. Woe betide the person or the industry that tries it. Who's for the defense?

Chemical Industry Supports the Foundation

DEVELOPMENTS during the past week in the proceedings of the government against the Chemical Foundation were marked by a very noticeable rally on the part of the chemical industry to the support of the Chemical Foundation. The Synthetic Organic Chemical Manufacturers' Association called on the President and expressed confidence in the Foundation and its management and argued against any interference on the part of the government on account of the adverse effect it would have on the development of our organic chemical industry. About the same time the National Association of Finishers of Cotton Fabrics adopted resolutions protesting against any action that might jeopardize the success of the organic chemical industry in this country and aid in re-establishing a German monopoly. Subsequently the American Chemical Society appointed a strong committee and requested an interview with the President, which, at the time of writing, had not been granted. It is to be hoped that the President will find time in the midst of the burdens laid upon him by the railroad and coal strikes to listen to the American Chemical Society's committee. In many respects it would speak more disinterestedly than our chemical trade associations and would add professional weight to the representations that have already been made. This committee comprises men of unquestioned eminence in the profession and integrity as citizens, and they could speak with authority and be heard with respect.

With this evidence of the unstinted support of the industry it may not be out of place to suggest that Mr. GARVAN be less active in speaking in his own behalf. His course thus far is not above criticism, and has added no weight to his cause. His letter to the President was in bad taste. His indulgence in flag-waving and eagle-screaming pyrotechnics accomplished specifically what he, and we, desired to avoid—namely, "to becloud the vital issue." The fireworks have been overplayed. Our distinct preference is to support the cause of the Chemical Foundation and consequently we dislike to see that cause jeopardized by indulgence in discourteous bombast. Let the Attorney-General do the talking and play his politics. Let the Chemical Foundation and the chemical industry acquit themselves in a dignified way under circumstances that are admittedly serious and trying.

Erratic Market In Building Construction

PRESENT times are marked by a deal of preaching on stabilization of markets and study of "the business cycle" and a remarkable disregard, in actual practice, of the principles preached. Those who have studied the great upward and downward swings that business in the United States has exhibited have been urging that men heed the obvious lesson of the business cycle and endeavor to make their expenditures when they can get the most for their money and curtail their expenditures when the dollar will not go so far; but the average man seems to study the indices of business conditions with precisely the opposite ambition. When he sees business is good he wants to "take hold" and *vice versa*.

The great ups and downs in business activity are not necessary. At least, neither those who have studied the matter most carefully nor those who have not studied it at all show any disposition to claim that they are necessary. The business cycle has no friends, yet it continues thriving.

There has been talk of "stabilizing" the coal market, by developing a plan whereby people would realize in summer that they will desire to burn coal next winter. The idea is feasible enough, for coal can be stored. One can carry a stock of greater or less amount, anything above zero. One cannot go short of coal, or consume more than he has. In building construction there is more leeway. One can build ahead of time or he can wait beyond the most desirable time, from the standpoint of convenience, and thus there is really more latitude in building than there is in the consumption of materials that are needed for manufacturing operations.

Despite this obvious fact, one observes that there is a more erratic market in building construction than there is in most commodity markets. We have spells when there is scarcely any construction and other spells, like the present, when building construction is extremely heavy. This is particularly true of dwelling-house construction. The only kind of building that has shown a strong tendency to take advantage of the business cycle is office building. It is the estimate of men well posted that about 85 per cent of all the skyscraper office buildings in the United States have been erected, or more accurately speaking, contracted for in times of business depression.

The present wave of dwelling-house construction

which is felt in nearly all sections of the country, is probably due to a great many men having come to the conclusion at the same time that "now is the time to build." The individual opinion probably was that others were going to build later, hence everyone tried to beat everyone else. Had it been possible to get a house actually built at the cost and within the time that were estimated last autumn or winter the builders might have realized their individual ambitions, but it is one thing to make an estimate and another thing to obtain the expected results. On account of the extreme activity many houses are costing more to build and are slower in construction than was estimated.

During the war it was commonly predicted that afterward there would be a period of several years of active building construction. The casual observer might think that now we have just entered upon the period and expect it to continue for several years at the present pace. The probability, however, is that this particular kind of activity will decrease as rapidly as it increased.

Ido Versus The Great Inertia

IN OUR columns this week we print a letter from one of our readers who has been interested in the Esperanto-Ido controversy. In the universal language idea he sees a great boon to technical men in general and he outlines a very logical program for the introduction of one of these universal languages into engineering work. The interest which has been aroused in this subject rather necessitates our taking a definite position in the matter.

Somewhat reprehensibly perhaps, our attitude toward a universal language has been *laissez faire*. We find ourselves asking the somewhat colloquial question—What's the idea? We find also that a vast majority of our contemporaries ask the same question and adopt the same attitude. That is the most serious drawback to the introduction of a universal language. Most people are not particularly interested in the subject and do not see the benefits that might accrue. The general attitude might be called a cold neutrality, which is unfortunate for any movement. An active opposition is better than neutrality, for it always gets the idea talked about pro and con, and excites an interest in the subject.

The general proposition of studying Ido or Esperanto for two or three months and then being able to read any scientific article in the world is rather tempting, and for the accomplished fact we can feel nothing but enthusiasm. Three or four years of French and German, to say nothing of Italian and Russian, rather makes the two or three months spent on Ido seem like a godsend, but alas, scientific literature at the present time is not printed in Ido and even if we spent two or three months learning it, it wouldn't do us a great deal of good. There's the rub. The tremendous difficulty of getting any publisher to print a column of Ido, let alone a whole magazine, would be well nigh insurmountable.

The plight of the metric system in the United States and Great Britain is an object lesson in this matter. Certainly, if ever there was logic in anything, the metric system should be adopted both in the United States and Great Britain, but it has not been adopted in either place and it will be many a long year before it is adopted as the exclusive system of weights and measures. The stone wall of current practice is a pretty difficult thing to surmount and if the metric system fails, how much more completely impossible would it be to introduce a new language. In Germany it is even impossible to avoid the use of an archaic style of printing. If we can't internationalize type, how can we hope to internationalize language?

There are many delightful pastimes and avocations in which we should like to indulge, but we are pressed with more serious business. Hence we shall forego the novelty of printing a column of Ido each week, and must decline to lend the active support of the magazine to the advancement of the cause of an international language. We fear we are part and parcel of the great inertia.

Raising the Standard of Chemical Engineering Education

THE OLDER half of this generation probably remembers the fly-by-night medical school which gave diplomas for a short course and permitted the recipient to use the title of doctor. This species of school and its products are now happily extinct or practically so. The most potent influence in eliminating them was the attitude of the American Medical Association toward medical education. It gave and continues to give its approval to medical courses which measure up to recognized standards of excellence. It did not give its approval to courses presented by institutions which did not live up to these standards. This naturally created a drift of students toward the better class of medical school, which was reinforced by the fact that the members of state licensing boards were members of the American Medical Association and graduates of reputable and approved institutions. Little by little the fly-by-night medical schools vanished.

A somewhat analogous situation exists in chemical engineering. There are schools in this country that turn out so-called chemical engineers inadequately trained, a menace to the profession because they call themselves chemical engineers. In unanimously adopting a program that calls for the approval of schools in chemical engineering which have recognized merits, the American Institute of Chemical Engineers has made a salutary and progressive move toward remedying an evil. Colleges and universities giving courses in chemical engineering undoubtedly will have due respect for the opinion of the American Institute of Chemical Engineers and will receive with courtesy its suggestion as to changes in curriculum. The approval of the Institute will mean much. But its failure to approve will mean more, because it will seriously militate against the popularity of the school in question. Students are quick to recognize that a course is regarded favorably or unfavorably in the profession and will very quickly flock to an approved school. With the possibility of disapproval imminent, the co-operation on the part of college and university authorities is likely to be prompt and enthusiastic. The Institute had loaded the old family shotgun with real ammunition instead of blank cartridges! It is to be congratulated on its courage and foresight.

There is perhaps one word of caution that should be uttered. In educational work a large part of the value received by the student is due to the personality of the professor, and this must be taken strongly into account in evaluating certain courses in any curriculum of chemical engineering. With due regard for the character of the personnel, as well as the nature of the course, the Institute can hardly go too far.

Readers' Views and Comments

To the Editor of Chemical and Metallurgical Engineering

SIR:—I note the good natured controversy in your columns between the proponents of Esperanto and Ido for an International language.

It appears to me that the supporters are trying to use the arguments of each for its being the best *universal* language and trying to make those arguments stick with regard to a limited field of usefulness. Without going into the merits of either as to a general field of usefulness in commerce, finance, politics, traveling, etc., it seems to me that what the engineer is interested in is a language adaptable to his immediate needs, so that in six weeks in college he may read any technical book or table of statistics. This would ultimately eliminate the necessity of two, three, or four years of French, German, etc.

It is my vague impression that for a universal, all-purpose language, the vocabulary should be so arranged that the root words are proportioned in number to the total number of prospective users speaking any language. That is, to be more clear, if the number of prospective users now speaking English is four hundred million or so, and the number of users speaking Arabic is also four hundred million or so, then the number of basic roots taken from the Arabic should be equal to the number taken from the English and so on. So much for all-purpose language. Now, since the Arabic speaking population can never be expected to shine in science or engineering, it would be useless to go to the Arabic for root words in any language intended for use only by technical men. Similarly with the Chinese, Esquimo, Abyssinian, etc., roots.

Hence it appears to me that any language which has its root words—that is, its vocabulary—pretty well rounded off with respect to the different European languages would be ample for all reasonable technical uses. It would seem that both Esperanto and Ido fall in this class, so we need not look further.

The matter of temporary deficiency of vocabulary is pretty easy to remedy since technical terms are to a quite appreciable extent internationalized anyway, numbers of them being coined each year from the Latin or Greek and adopted unchanged, or only slightly so, throughout the technical world. The general vocabularies of both languages are probably already pretty complete so their adaptability to expression of thought may be considered to be ample.

There remains only the question of the introduction of the particular language chosen. Should this language never come into general public use but remain forever a technical language, there would be only a small loss to each individual as I am told that any of them can be very well learned in a few months. Furthermore, it would be no considerable task to introduce one or the other, and receive its benefits soon. A commercial language could come along later.

I would suggest that the various large technical societies hold a convention, choose and recommend whichever seems best fitted for the use of the members speaking that particular native tongue. The next step would be an international convention of technical bodies and government representatives to thresh out the same question for the technical world as a whole. This recommendation would be final but would still be only recommendation. The third step would be a tryout. Such bodies as the Bureau of Standards, the Smithsonian Institute, the Naval Observatory, and like bodies in other countries would then publish their statistical works in the form of an interlinear translation, that is, the works would be published as at present but with the addition that after the explanation in the native tongue, the same explanation in, say Esperanto, would follow. This would incur very small expense as in such works as the Smithsonian Tables, the numbers are the main thing and the explanations generally occupy only a few lines per page. If British, French, and German organizations followed suit, this would be a very efficient and economical tryout.

Should this be favorable, the fourth step would be more daring. Some magazine, for instance this one, could publish for a couple of years a double issue as is now published by the magazine *Sugar* which has a Spanish edition bound in with the English edition. This would be more expensive as a tryout, but if still successful we are off, and are at once receiving the benefits of the new international technical language. Other magazines, and even book publishers would shortly fall into line. Further, if a success, this very success would stimulate the use of this or another similar language in commerce, and other foreign intercourse.

I hope my ideas will be of interest to you.

Washington, D. C., M. SHERRILL.
States Relation Service,
O. H. E.

Manufacture of Hydrogen Peroxide

To the Editor of Chemical & Metallurgical Engineering

SIR:—More than forty years ago the writer was chemist and manager for Charles Marchand, an ingenious Frenchman who first made H_2O_2 a commercial success. In that capacity I worked out a method for the manufacture of BaO_2, under which many tons of this material were produced. While working in this line the late Professor Joy of Columbia drew my attention to the reaction with CO_2 and I made a number of experiments, producing considerable quantities of hydrogen peroxide at various times without observing that the product was more unstable than that made by Marchand with Thenard's process. But later I went into the experiments much more intensively and completely and was therefore much surprised at the article in your issue of June 14, 1922,[1] re-describing the same process, for this must have been tried by many besides myself.

When I repeated my experiments, now many years ago, the process was carried on in a pressure vessel kept in motion continually and at a pressure of about 100 lb. to the inch. From the first no attempt was made to work the method in unlined vessels and the wrought-iron pressure tank was lined with porcelain

[1] "Hydrogen Peroxide—A Novel Process for Its Manufacture," by H. A. Doerner, *Chem. & Met. Eng.*, vol. 26, No. 4, pp. 1111-2, June 14, 1922.

bricks of the same quality as used in cylinder mills, but of smaller size. These bricks were cemented together with caustic baryta, which sets into a very hard binder, apparently expanding slightly, like plaster of paris. Many difficulties were encountered and overcome, but there was one not mentioned in that article, which resulted from the production of barium percarbonate and proved more troublesome than all the rest. Under pressure a sort of bi-percarbonate seems to form, probably of the composition BaC_2O_6. This is very unstable, somewhat soluble, at least in the carbonic-acid solution and when removed by H_2SO_4 it is prone to cause a loss of oxygen which should have been held in the peroxide.

The product was never handled commercially, for the high price of CO_2 at that time made it impracticable. Besides, I became convinced that it was one of those things which must be handled on a large scale to be economical and enable the use of comparatively unskilled labor. But the process has undoubted possibilities, and what I did before abandoning the thing convinced me that there were no obstacles that were not easily surmountable. Unfortunately, my notes are not accessible, so that I rely upon memory and cannot go into details, but the process as described in your article is practically a replica, on a rather larger scale, of what was done years ago.

H. B. GOETSCHIUS.

Roscoe, Sullivan County, N. Y.

Should Engineers Be Licensed?

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is evident from an editorial in the July 5th issue of *Chemical & Metallurgical Engineering* that the laws passed in several states providing for the licensing of all engineers who wish to engage in the practice of professional engineering do not meet with your approval. You point out several possible faults in the scheme.

The editorial states that, whether he likes it or not, the engineer finds himself restricted or hampered by incompetent legislation. I wish to point out that no qualified engineer is restricted or hampered by the New York law in the performance of any professional work that he could with honesty and from an ethical standpoint hope to perform.

You "gravely question whether any good can come of licensing engineers whose work requires the exercise of initiative, ingenuity, judgment or the creative faculties." Let us consider the question of judgment. The lives of all depend on the judgment of engineers and, under a licensing law properly enforced, the risks which we must run will be lessened, for an engineer will never make more than one mistake in judgment which adversely affects public safety; and his disbarment after failure will be an impressive lesson to others who might commit the same errors of judgment. You would confine the license to only such engineers as are responsible for public works. I say that the chemical engineer responsible for a plant liable to explosions or other dangerous accidents may, by his errors in judgment, jeopardize the public safety fully as much as could a bridge designer responsible for a highway bridge. The license law must apply to all engineers on a basis of full equality.

Your editorial goes on to state that licensing of physicians has not worked miracles with the medical profession. No, nor can licensing work miracles with engineering. Truly, we shall choose our engineers as we do our physicians—for proved ability. But licensing of physicians helps enormously to keep the shysters out of the medical profession and we can expect with confidence that in time the license will do as much for engineering. The license certificate cannot, as you point out, make a good engineer out of a poor one and, in the wildest flights of fancy, no one connected with the passage of licensing laws ever expected that is could. But it does not prevent the totally unqualified man from representing himself to a more or less gullible public in the guise of an expert—an occurrence which is not rare, as those who were stung in the "efficiency" engineer fake of some ten years ago will testify in choice language and with much feeling.

The last objection raised by the editorial is that the license certificate does not differentiate between types of engineering practice. To do so would be really to hamper the engineer. He should have the latitude to perform as large a service as he is able to compass. And it is certainly up to the individual engineer to run no risk of losing his license by trying to do work for which his experience and training do not qualify him. Under the law we have the same safeguards that we formerly had against such malpractice with added protection due to each engineer's anxiety so to conduct himself that his license cannot be revoked.

If you will study the law with care you will find that, at least in so far as the New York law is concerned, the fears evoked in your editorial are all chimeras. Prior to the law's passage, the only real opposition it had came from corporations and their hired engineers who vainly hoped, by maintaining the engineer in a position of public disregard, to continue the then situation—when brains could be hired by the unscrupulous for nothing a week. It would give me cause for great amazement and regret to see *Chem. & Met.* definitely line up in such discredited company.

ONE OF THE "ENERGETIC MINORITY".

New York City.

Electric-Furnace Production of Phosphoric Acid

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your report of the Niagara Falls meeting of the American Institute of Chemical Engineers, there is one matter to which I should like to call your attention.

Referring to the discussion by W. H. Waggaman on the production of phosphoric acid, there is not a clear distinction between the furnace using fuel as a source of heat and the electric furnace. The passage in question is on page 13 of your issue for July 5.

I wish to clarify reference to the mention of a plant "designed by one of the men formerly with the Bureau of Soils." This plant is not in any sense connected with the experimental work of Mr. Waggaman on fuel-fired furnaces and is not in an "investigation stage." On the contrary, it is a full size plant, and regularly producing considerable quantity of phosphoric acid. Further, the reference to the short runs and comparative estimates on the cost of producing phosphoric acid refers to the work of Mr. Waggaman and not the acid work at Anniston.

So far as is known to the writer, the basis of comparison of cost of production of phosphoric acid is the result of Mr. Waggaman's short runs and estimated cost on electric furnaces as published by the writer while connected with the Bureau of Soils.

J. N. CAROTHERS.

Federal Phosphorus Co
Anniston, Ala.

Automatic Equipment and Chemical Control

The Beverage Industry Based on Automatic Equipment for Competitive Purposes and Chemical Control for Purity—Description of the Beech-Nut Packing Co.'s Ginger Ale Plant at Canajoharie, N. Y., an Illustration of the Combination of These Two Important Methods

By Graham L. Montgomery

TO KEEP a continuous, active market for a beverage, the manufacturer must meet three main essential requirements. The price must be such that the product can hold its place in a highly competitive market. The flavor, quality and purity of the beverage must be such as to create a continuous demand among consumers. The beverage must be so made as to be acceptable under all state and federal pure food and health laws.

On the matter of price, the raw materials which enter into the manufacture of beverages are only a slight fraction of the cost of the finished and bottled product. Also, these materials present no particular chance of advantage, as the price fluctuations in the long run will equalize their cost for all manufacturers.

The possibilities of savings lie then in the manufacturing costs. This fact was early recognized by the industry at large and as a consequence, we find that automatic machinery and handling devices are employed by these manufacturers wherever there is any possibility of effective use of this equipment.

The matter of flavor, quality and purity necessary to create and maintain a popular demand is so tightly bound to the matter of purity to comply with the law that these two essentials must be considered as under one head. To accomplish these results it is necessary to establish and maintain a strict chemical and bacteriological check on all stages of the manufacture and bottling of the beverage.

Some Essentials of Beverage Manufacture

Before passing to the specific example of modern beverage manufacturing practice which forms the major portion of this article, there are certain essentials of manufacture which those interested in this industry should bear in mind.

In the first place, all the raw materials used must be pure and of good quality. Water forms the greater part of all non-alcoholic drinks and particular care must be exercised to obtain a pure water of good flavor with the proper degree of hardness. The other materials—those used to make up the flavoring of the beverage—should be absolutely unadulterated, fresh and of good flavor. If these essentials of quality are observed in the selection of the water and other materials it becomes possible to fix on a blend of pleasing flavor and to maintain this constant at all times.

Most of the popular beverages are charged with CO_2 or carbonated. If any bottles of such a beverage reach the consumer in a flat condition, *i.e.*, with the CO_2 discharged, there is much complaint and the sales of that particular beverage are likely to be materially lessened. Hence the successful manufacturer goes to some little trouble and expense to see that the bottles of his beverage are uniformly charged and are sealed tight.

Among items which will not be stressed here but which have a direct influence on the manufacturer's success might be mentioned the control of a supply of bottles and packing-cases. It is evident with but little consideration that any advantages a manufacturer can obtain along this line will be of direct advantage in enabling him to keep costs at a minimum.

The Beech-Nut Packing Company

The Beech-Nut Packing Co., manufacturers of various food products, has been located at Canajoharie, N. Y., for many years. When they contemplated the addition of non-alcohol beverages such as ginger-ale and root-beer to their products, this location was found to be fully as good as could be found elsewhere for the purpose.

As stated above, the largest part of these "soft" drinks consists of water. A few miles north of the town of Canajoharie, in the foothills of the Adirondack Mountains, are located the Sprite springs, yielding a large supply of exceptionally pure water with low mineral content. These springs were acquired and now form the basis of the manufacture of beverages at Canajoharie. The water has sufficient head to flow naturally to the plant site. The watershed of the springs has been fenced and is well guarded against pollution.

Method of Purifying the Water

On first entering the plant the water passes through a meter. Immediately after the meter are four Bowden filters, piped in parallel so that one or two units can be out of use for cleaning or refilling. The water in passing through these filters encounters first a layer of coarse quartz, then a layer of fine quartz, and finally a layer of bone coal. This first filtering serves to remove all coarse suspended matter and the bone coal absorbs any cloudiness or odors which may be in the water.

After passing the Bowden filters, the water goes through one of four International filters. These are arranged in parallel in a similar manner to the first filters. The filtering medium consists of a thick, dense filter paper, protected on the inlet side by a cover of loosely woven cotton cloth which serves to intercept any of the bone coal which might be carried over from the first filter. The International and Bowden filters remove practically all material from the water which can possibly be removed by filtering.

Beyond the filters, the water flows through the sterilizers. These are of the ultra-violet ray type and consist of two concrete tanks, either one of which can take the whole load of the plant. In each tank are two weirs with openings about 4 inches long and ⅛-in. deep, through which the water flows slowly, passing over the tube containing the arc which produces the ultra-violet ray.

The accompanying photograph of the water purification department shows the Bowden filters on the right, the International filters in the center and the sterilizers on the left.

After passing through the sterilizer, the water flows by gravity to the floor below. There it is divided into three streams, the largest to be carbonated, a second

to form the solvent for mixing the flavoring syrup and the remainder to be used for washing and rinsing bottles.

How the Water Is Carbonated

The bottling process used by the Beech-Nut Company is that known as the low-pressure process. This process depends on the fact that water at a low temperature will absorb and retain a far greater amount of CO_2 than at ordinary temperatures. For this reason the water which is to be carbonated is first passed over a direct expansion cooling coil supplied with a cooling medium from a 75-ton compression refrigerating set. This cools the water to an average temperature of 34 deg. F., a check being maintained on this temperature by means of a Foxboro recording thermometer.

After passing the cooling coil, the water enters the carbonators. These five machines, manufactured by the Liquid Carbonic Co., operate automatically, being governed through liquid level and counterweight so that when the carbonated water in the base of the machine is drawn off below a fixed low level, the machine starts to operate and continues to do so until the carbonated water level reaches a fixed high level. There are five of these machines operating in parallel on the pipe line between the cooling coil and the filling machines on the next floor below.

The operation of the carbonating machines, shown in the accompanying illustration, is as follows. The water is pumped in at the top of the column shown on the forward part of the machine by a geared pump, located at the rear of the machine. As it falls down through this column it is broken up into a fine spray. This spray comes into contact with CO_2 gas coming upward through the column. The CO_2 is introduced at the bottom of the machine where the main casting forms a reservoir for carbonated water. The gas bubbles up through this agitated water maintaining the saturated condition which the water acquired in the column. The CO_2 is received in pressure cylinders at 750 lb. pressure and is fed to the carbonator, through a reducing valve, at a pressure of 75 lb. A Foxboro recording pressure gage is installed on this pipe line.

As it is required in the bottling process taking place on the floor below, the charged water is drawn off from the carbonators through Berkefeld filters, shown on the left of the same illustration which shows these carbonators. After passing through these filters the water tests negative under all bacteriological tests.

The water to be used in syrup making flows as needed from the sterilizers to the copper heating kettles in which it is heated, together with sugar, to form the simple sugar syrup which is the basis of the flavored syrup used in the various beverages.

The water which is to be used to wash and rinse bottles is delivered by a pump situated on the same floor as the carbonators, the third floor. This pump takes the water from the sterilizers on the fourth floor and delivers it to the soaking and rinsing machines on the second floor at the pressure and in the quantity desired.

Manufacture of Flavoring Extract

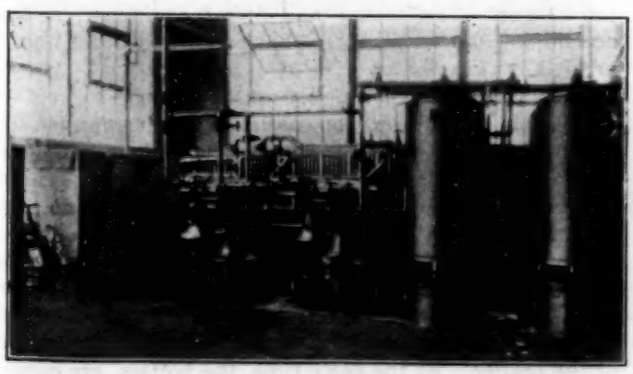
At the Beech-Nut Company's ginger-ale plant, the materials which go to make up the flavoring extract are purchased in as near the raw or original state as possible. It is easier in this way to get pure materials and to control the blend so as to have the flavor exactly the same at all times.

For the purpose of illustrating how the extract is made let us consider that used in flavoring ginger ale. The basis of this flavor is ginger root. Other vegetable products that can be directly extracted are handled in the same way. This root is first pulverized in a Jeffrey pulverizing mill. The pulverized material is then placed in a percolator. The percolators used are of heavily tinned sheet metal and in general design are like a large funnel. These percolators, removably suspended from the room ceiling by hooks, are provided with covers and with valves at their lower or discharge ends. The material to be extracted, about 150 lb. at a time, is placed in a cloth bag and suspended in the percolator. Pure grain alcohol is then allowed to trickle down through the pulverized mass, thus extracting the flavor of the ginger or other material.

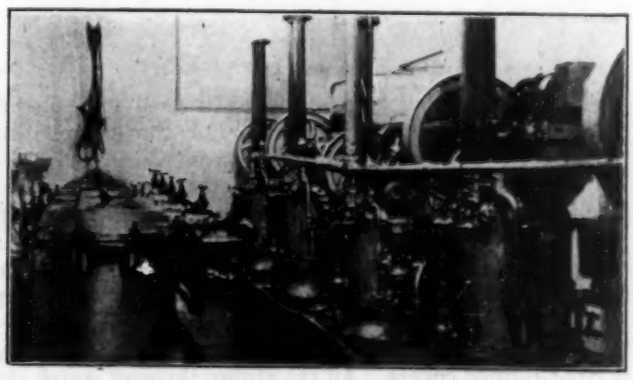
The crude extract which comes from the percolators contains a small amount of tarry material from the ginger roots. To get rid of this, the extract is placed in a Pfaudler glass-lined agitating tank with distilled water and thoroughly washed.

A certain amount of alcohol remains in the woody mass of waste removed from the percolator after the extracting is finished. To recover this, the waste is placed in a small Tolhurst centrifugal extractor. This machine recovers all but a small proportion of the alcohol, which can be purified by distillation and reused.

The essential oils of lime, lemon and orange are used in the flavoring of many soft drinks including ginger-ale. These oils are purchased in the crude state. In this condition they contain terpene and must be refined by extracting the terpene with alcohol. By doing this refining at the plant, it is possible to keep the strength, quality and purity of the refined oil always the same. These factors would not be so easy to control if the oils were purchased in the refined state.



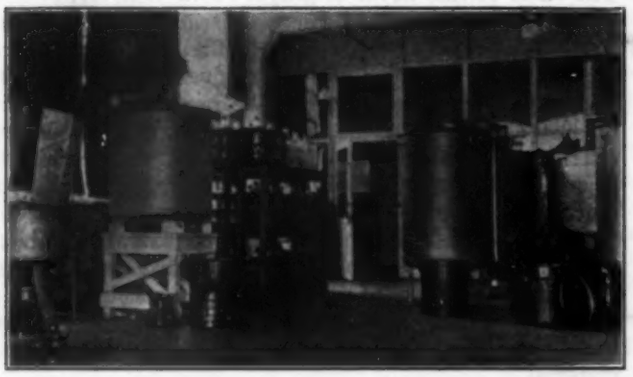
WATER PURIFICATION APPARATUS



CARBONATORS AND BERKEFELD FILTERS

The extract and the essential oil are both carefully filtered through paper. They are then placed in one of the storage tanks in the proper proportion to produce the desired flavor and allowed to age, which improves the blend. Handling of the extracts, of the essential oils and of the blend of the two is accomplished by means of the portable centrifugal pumping set and the copper cans shown in the accompanying photograph.

This photograph shows on the left the Tolhurst centrifugal extractor, next the Pfaudler glass-lined agitating tank; in the center a stack of the bottles used for essential oil containers and on the right, the six storage tanks and the portable pump. The storage tanks are Pfaudler glass-lined tanks with covers lined with block tin. All are provided with gage glasses to show the depth of the liquid contained. The two shown in the rear are of 600 gal. capacity each for the storage



of the blend. In front of these on the left are two of 200 gal. capacity for distilled water. On the right, only partially shown, are two 200 gal. tanks for storage of the pure grain alcohol.

How the Flavoring Syrup Is Compounded

In a previous paragraph, notice was taken of the compounding of the simple sugar syrup of sterilized water and cane sugar in a heating kettle. Then this mixture is pumped to the mixing department on the fourth floor adjacent to the water purification system. In this department are four 350-gal. Pfaudler glass-lined tanks, a small pump and a Sweetland filter. To a measured quantity of this syrup the proper proportions of the blend of citric acid crystals, and of caramel or burnt sugar coloring are added. Here is performed the operation known as polishing the syrup. Two of the tanks are used for unpolished syrup and two for polished or filtered syrup. By means of the pump the syrup is forced from one set of tanks to the other through the filter. This leaves the syrup clear and brilliant and thoroughly mixed.

Syrup Storage Department

To keep the flavoring syrup until used it is necessary to store it in a cool place. For this reason this department is included within the same insulated walls on the third floor which inclose the sterilized water cooling coil and the carbonating or charging department. Within this space is a room maintained at a temperature of 40 deg. F. by cooling coils and containing four 600-gal. Pfaudler glass-lined tanks for syrup storage.

These tanks are provided with gage glasses and have block-tin-lined covers. All the piping through which the syrup or carbonated water must pass is block tin lined. A Foxboro recording thermometer is installed in the storage room to keep a check on the temperature.

Where the Automatic Equipment Is Used

The preparation of the carbonated water and of the syrup has been described above. These two elements are mixed in the proper proportion to form the completed ginger ale in the bottle at the time of filling.

It will be noticed in the descriptions of processes outlined above that most of the material is handled by pumps or by gravity flow in pipes. The bulk materials to be handled—sugar, ginger root, essential oils, etc.—are very small compared to the amount of liquids. The carbonating equipment is automatic. In the other processes there is little possibility of finding better equipment than that described. Only from four to five men are needed throughout this whole series of operations.

But when we come to the work of placing the ginger ale in the bottles, we find a situation in which the use of any hand labor would be extremely costly. For this reason automatic machines were long ago designed and are now generally employed in this work.

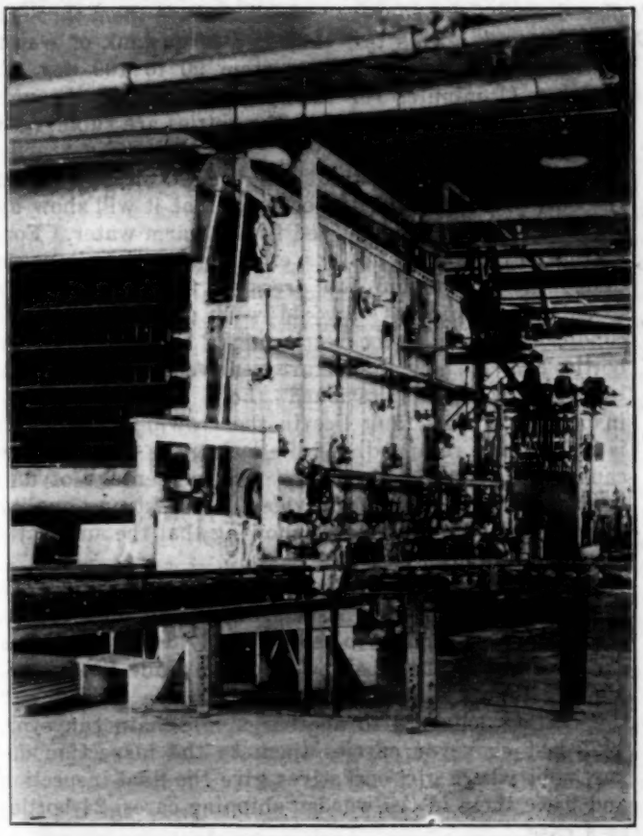
Division Between Manufacturing and Handling of Finished Product

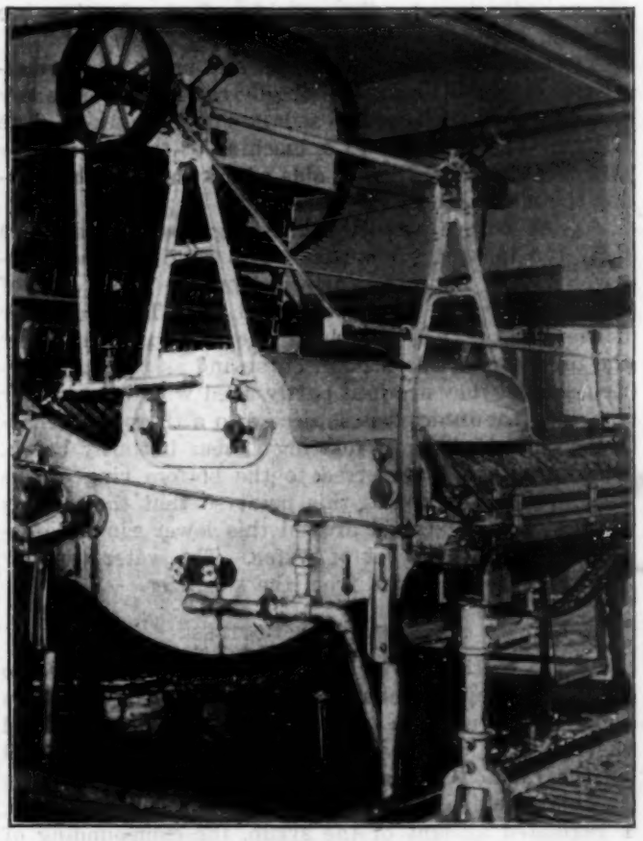
The work of filling the bottles would be classed entirely as handling of finished products except that the mixing of the carbonated water and the syrup takes place in the bottle. For this reason the automatic equipment for handling the bottles and filling and labelling them will be described in this article. The handling equipment used other than that in connection with the automatic machines here described will be the subject of an article entitled "Handling the Finished Products of Industry—IV" to appear in *Chemical & Metallurgical Engineering* for August 2, 1922.

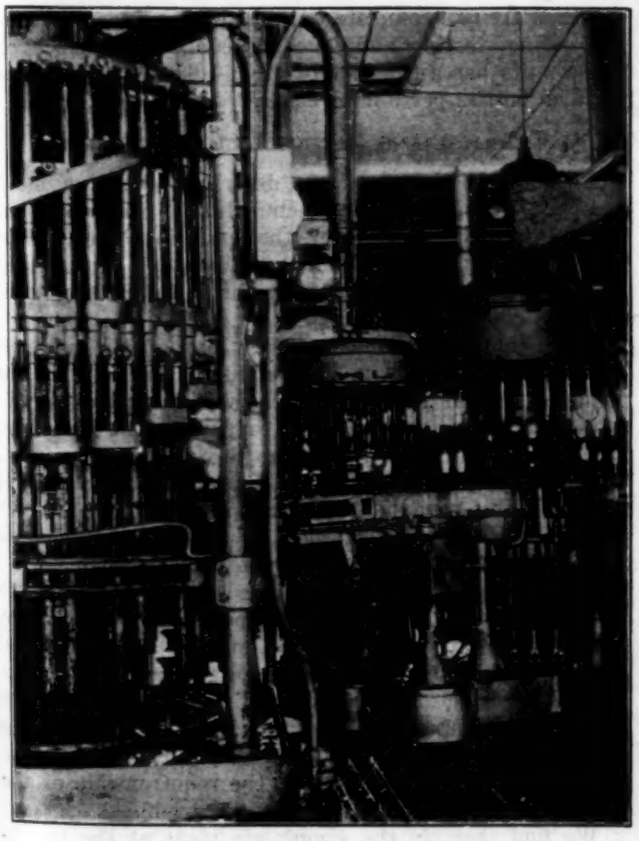
Work Done on Bottles Prior to Filling

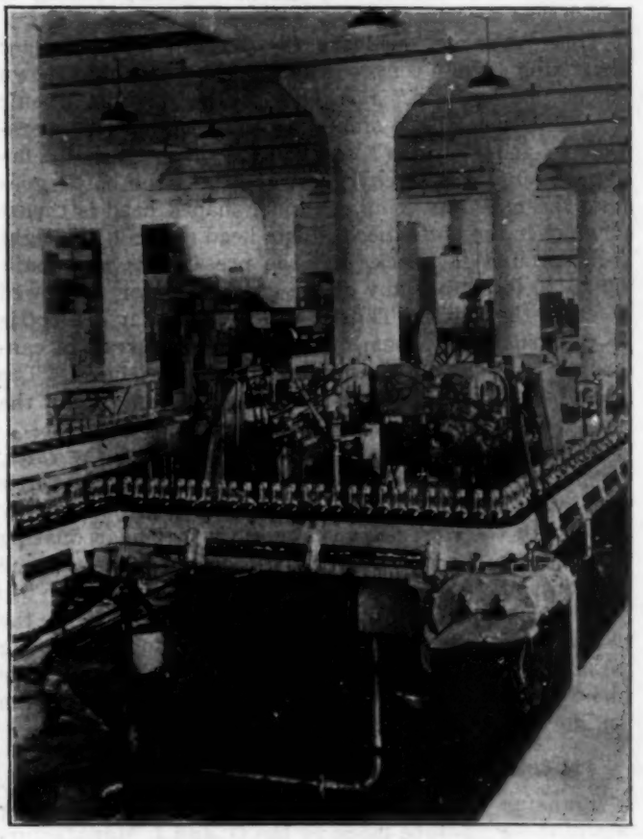
All bottles received at the plant must be thoroughly cleansed before they are filled, whether they are new bottles or bottles returned from dealers. The first operation of this cleansing is performed in the soaker manufactured by Barry-Wehmiller and shown in the accompanying photograph. As can be seen in the picture, the machine consists of five large tanks through which the bottles are carried, 15 abreast, held in the compartments of the chain. The first three tanks are filled with a hot caustic soda solution and the last two are filled with warm sterilized water. The chain makes one upward pass and one downward pass through each tank. Thirty minutes are consumed in passing through the soaker. The soaker and filling equipment are on second floor of the plant, so that water and other liquids are fed by gravity.

The bottles are thoroughly washed in the soaker but any labels which were on returned bottles might still remain on them. So after leaving the soaker the bottles are discharged from the chain compartments, automatically, and go through the brushing machine, also manufactured by Barry-Wehmiller. Channels on an incline receive the bottles as discharged and serve to keep them separate and equally spaced. The bottles slide down these channels under the brushes which rotate on horizontal axes perpendicular to the travel of the bottles. At the same time, the bottles are caused









UPPER LEFT—SOAKER WITH RINSER BEYOND
LOWER LEFT—RINSER AND FILLING HEADS

UPPER RIGHT—BRUSH AT REAR OF SOAKER
LOWER RIGHT—LABELLER AND BOTTLE CHAIN

to rotate on their axes. In this way any labels or other things adhering to the outside of the bottles are brushed off.

After having passed the soaker and brush, it is necessary that the bottles be thoroughly rinsed to remove any possible traces of caustic soda. This rinsing is done with an Arrow Bottlers Co. machine of the rotary type which is shown on the left side of the photograph showing the filling heads.

As the bottles leave the brushing machine they are delivered in an upright position to a single-chain conveyor having flat plates attached on the upper side of its links for the bottles to stand on. This conveyor delivers the bottles directly to the rinser. They enter the top ring of this machine first and as they are carried around they are first partly filled with warm water and then the interior is subjected to a thorough brushing with a high-speed rotating rubber butterfly brush. They are then transferred to the bottom ring of the rinser, being turned at this point so that the neck is down. As they travel around this lower ring the inside is rinsed by a jet of water. The water used by this machine all comes from the sterilizer.

Filling the Bottles

As the bottles leave the rinser they are delivered to a chain conveyor similar to that described above. This conveyor moves them to the first filling machine, called the "syruper," a rotary filling machine manufactured by the Liquid Carbonic Co. As the bottles are taken on this machine and caused to travel around its ring, a regulated amount of the syrup, the compounding of which was described above, is placed in each bottle.

This "syruper" delivers the bottles, over another short single chain conveyor, to the filling machine known as the "filling head," also made by the Liquid Carbonic Co. This machine is similar in construction and operation to the "syruper" except that it is specially designed for use with charged water. As the bottle goes onto the machines' ring, a funnel shaped head is thrust down over the bottle neck. This head makes a gas tight joint around the neck, and the pressure is then built up to 20 lb. before any of the charged water is allowed to enter the bottle. Thus it will be seen that if a bottle is cracked or for some other reason the pressure cannot be built up, no charged water is introduced. The operator picks out these bottles which have only the syrup in them and discards them.

If the bottle will stand the 20-lb. pressure, the valve, on the end of a tube which is projected into the bottle to a point near its bottom, opens and the bottle is gently filled with the cold charged water from the carbonating machines on the floor above. By introducing the charged water in this way it is intimately mixed with the syrup without undue foaming. As both the syrup and the charged water are at a temperature close to the freezing point, there is no undue escape of carbon-dioxide in the short period during which the bottles pass from the "filling head" to the crowning machine.

Crowning, Testing and Labelling Bottles

Transfer from the "filling head" to the crowning machine—a machine made by the O. and J. Manufacturing Co.—is made by means of another single-chain conveyor. This crowning machine crimps the caps on over the lip at the mouth of the bottle.

As the bottles come out of the crowning machine they are placed by hand upright in galvanized wire baskets holding about two dozen bottles each. These baskets are placed on the slat conveyor which conveys them through the test tank. This test tank is a large tank of water maintained at a temperature from 90 to 100 deg. F. It takes 11 minutes for the conveyor to pass through the tank and during this time the bottles are submerged in the warm water.

If there is any possibility of the CO_2 leaking from the bottles and leaving the beverage flat it will show up while the bottle is submerged in the warm water. For, as the bottle warms up, gas escapes into the air space under the crown and the pressure rapidly builds up to as high a point as it would reach under any normal conditions to which the bottle might be exposed. Any bottles which show a leak are removed from the tank by the workman stationed there and thoroughly inspected. If the fault lies in the crowning the bottle is refilled and recapped. If the leakage is due to other causes the bottle is discarded. The percentage of discards is extremely small provided a good strong quality of bottles has been obtained, showing that the automatic machinery is highly efficient.

As the bottles emerge from the testing tank they are removed from the wire baskets and placed on a single-chain conveyor similar to those already described. This carries them to the labelling machine, made by O. & J. Manufacturing Co. Here the labels are affixed and the bottles delivered to another single-chain conveyor. This last conveyor carries them to the inspection department where girl operatives give the final inspection and place them in the wooden shipping cases, 24 bottles to a case.

There are two complete units of this automatic washing, filling, testing and labelling equipment. Each of these units has a capacity of from 1,600 to 1,700 cases of filled bottles per 9-hour day.

Chemical and Bacteriological Control

Throughout the processes described above, a most complete and exhaustive chemical and bacteriological control is maintained over the materials used. The plant is provided with a large laboratory, extensively equipped so that all types of chemical and bacteriological tests can be conducted.

Chemical tests are made on each item of raw material which goes to make up the product. These tests are made at regular intervals on the water and bulk products and on each container of the small quantity products. As these materials go through the processes, regular tests are made after the completion of each step. In this way the quality and flavor of the product can be uniformly maintained at the point which has been determined to best meet the popular taste.

Bacteriological tests are made of the water as it enters the plant, after each step of the processes to which the water is subjected, of the various other liquids used in the manufacture, of the finished product and of the bottles, both before and after cleaning. These enables the company to be sure that the product leaving their plant has a low bacteria count, that the public health is safeguarded and that the requirements of the various pure food and health laws are fulfilled.

We find then, in the ginger ale plant of the Beech-Nut Packing Co., an almost ideal combination of automatic equipment and chemical control—a combination by means of which manufacturing costs are maintained at the lowest figure and at the same time quality of product is maintained at the highest level.

The Society of Chemical Industry Meets in Glasgow, July 4 to 11, 1922

An Intimate Glimpse of This Live Organization in Action—This Meeting Was a Notable One in Every Way—Abstracts of the Technical Papers Follow the Account of the Meeting

By Ellwood Hendrick

THIS is the fourth time the Society has met in this city since its organization in 1881 and—"Glasgow knows how." It knows how to do many things, not the least of which is to operate successfully a municipality of a million and a half inhabitants—and nearly all of them Scotch. This latter fact may indicate the reason why. The street railways are municipally owned and a short ride costs a penny, which is two cents, and a long one four pence. The city makes its own gas and works up the residues. It produces its own electric current at exceedingly low cost. It has no Tammany Society nor any Republican County Committee nor any Hearst papers. Its policemen and cab-drivers are said to be mostly Irishmen from over Belfast way. Its climate is only theoretically mild for on the 4th of July a straw hat is more of a curiosity on the streets than an overcoat.

Glasgow's Industrial Power

Glasgow is the site of its University and of its Technical College, which is a branch of the University. It is headquarters for many chemical industries and there are important steel works nearby, at the south. The minerals of the district include iron, coal, shale, clays, zinc, lead and its chemical industries are shale oil, tar distillation, alkali and acids, cyanides, ferrocyanides, bichromates, iodine, explosives (Nobel Works), oils, paints, fertilizers and a great many more. The section of the Society is a lively one and its members are people of influence.

An Informed and Admirable Lord Provost

At the opening of the meeting in the council room of the beautiful Engineers and Shipbuilders' Institute on July 4, each registrant received a handbook of the meeting, handsomely bound in Gordon plaid, a guide to Glasgow, another guide to Scotland and copies or abstracts of all the papers to be presented. At 10 o'clock the Council, about 24 members being present, met for routine business but left the location of the next annual meeting to be determined later. Dr. E. F. Armstrong had already been chosen president for the next year. At 10:45 the annual general meeting reaffirmed the action of the council and the Lord Provost of Glasgow delivered a speech of welcome.

Now the Lord Provost fulfils the functions of the Mayor of the city, and his broad grasp of the meaning of chemical industry, the absence of silly pleasantries from his address, and his earnest participation in the purposes and aims of the meeting made your correspondent wish for that kind of a mayor in his home town.

The president, Dr. Ruttan of Montreal, responded gracefully in appreciation of the welcome from the city that gave us, among others, Joseph Black, Charles Tennant, Kelvin, Sheldon, Ramsay—all of whom were Glasgow men. In his presidential address, Dr. Ruttan gave an extensive and complete history of research in British possessions since the outbreak of the war and a very thoughtful study of the available methods of developing the resources of the empire. The stimulus of the meeting in Canada and of the International meeting in New York last year was duly recognized, but his problem had to do with carrying on the development and keeping up the general and public interest in research. His conclusion—and he gave many reasons in support of it—was that a series of colonial and imperial institutes of research be organized somewhat on the line of the Mellon Institute at Pittsburgh, would be the best solution. Out of the inter-relations of such establishments in the various British possessions he believed that great good might come. His information as to the present status of the various Research Institutes of Canada, Australia, New Zealand, South Africa, India, and elsewhere shed additional light on his proposal.

President-elect Armstrong, in the discussion which followed, spoke of the hazard of a possible bureaucratic control of research as his only criticism of the plan. In a considerable number of cases in various countries since the war, the efforts made to organize research have taught him to fear the ill-effects of too much of this good thing.

At 1 o'clock an informal luncheon was held at the Grosvenor restaurant in Gordon Street, Glasgow's leading establishment of its kind. Mr. J. H. Young, chairman of the Glasgow section presided, and he and Dr. Ruttan made short but pleasing addresses. There were about 300 present.

At 3 o'clock the party went out on special street cars to a garden party at the house of Mr. David Parry, a leading alkali manufacturer of Glasgow and president of the Society in 1905-06. He has a beautiful estate and here were marquees and settles and awnings, with all the paraphenalia of a garden party, and a band and Scotch pipers, and the famous Glasgow cakes, and dancers who did the highland fling, and there was sunshine and many beautiful Scotch ladies.

The Reception

At 7:30 o'clock (they have daylight saving time, and at this latitude it hardly grows dark until the clock strikes 11) the Hon. Lord Provost and the magistrates of Glasgow received the members of the Society and ladies with them at the great Municipal Buildings. The Lord Provost and the Magistrates in their robes of office, respectively in purple and black and ermine, and with golden chains and medallions, received each guest with ceremony. Then a procession was formed of their eminences and the president, officers, and a few members of the Society, including the representative of the American Section, who took place on the platform of the great hall. Before them were gathered the members of the society and many distinguished persons, invited by the municipality—a large conclave, all in evening dress, including some gentlemen who wore the kilts of their clans. The Lord Provost spoke of the great value to the city which the application of chemistry had proved, how through the efforts of Mr.

Walmsley great savings had been made in their gas products recovery plants. Dr. Ruttan said the right thing and Mr. Young made a plea for the greater glory of chemistry, after which the dancing began.

But some of us are getting along in years and a trifle stiff in the legs, so that for such that did not dance another entertainment was provided. This was in the council chamber where the Glasgow Select Choir, and organization of 18 mixed voices sang, *a capella*, from 8 until 10. This is a famous body of musicians and they have sung in the United States and Canada as well as all over Great Britain. Now after sitting through the concert, the writer of these lines challenges any reader of them to hear the Glasgow Select Choir sing "The Auld Hoose" without getting a bit thick in the throat or wet in the eye, or "Scots wha' hae" without imagining himself a Scotsman and almost feeling as if he could tear up the whole of Mount Vesuvius if he had a mind to. In addition to all this a bountiful collation was served.

Glasgow wants it understood that it believes in and approves of chemistry and chemists. It knows what they are because it has raised them.

Award of the Messel Medal to Prof. Armstrong

Wednesday the 5th was just as lively a day. It began with the first Messel Memorial lecture by Professor Henry E. Armstrong. The late Dr. Rudolph Messel, who many of our readers will remember as president of the Society during the eigth International Congress of Applied Chemistry at New York in 1912, left £20,000 to the society by his will. The Society resolved to give a medal bearing the name and likeness of the donor to the most distinguished chemist of his time in England as the occasion for doing so may arise. Professor Armstrong was the choice this year and his address bore the title, "Rhapsodies Culled from the Thionic Epos." The speaker's delivery was too rapid and mild in voice for the writer to gather more than random notes from it, but we may say that that was the only evidence of mildness which the speaker displayed in his delivery. Professor Armstrong is as peppery as ever and the substance of his discourse was a plea to get back to chemistry, interspersed with frequent flashes of wit and a crack on the head for everyone who did not agree with him. It will probably be published in the form of a booklet and it will make lively reading.

Two technological papers followed on "A Rapid and Accurate Method for the Calibration of Storage Tanks," by Dr. J. W. McDavid and "The Viscosity of Cellulose in Cuprammonium Hydroxide" by Dr. R. A. Joyner, both of the Noble works. They are abstracted below.

An informal luncheon took place again at 1 o'clock and this time the Principal of the University made a short but fitting and very polished address of welcome.

Two excursions followed: to the Provan Chemical Works and the Dalmarnock Power Station.

The Provan Chemical Works is the largest of four units owned and operated by the City of Glasgow for the distillation of tar and ammonia, one being located at each of its gas plants. That is, the crude distillation of tar is done at the other works, whilst the refining is done at Provan. Notes on this plant and the power station will be found elsewhere.

In the evening came the banquet with President Ruttan as Toastmaster and the Lord and Lady Provost of Glasgow and about 300 persons all told. The toasts were "The King", "The Queen, the Prince of Wales, and members of the Royal Family," given by the chairman. A song followed by a Scotch lass who claimed she was lonely, but we doubt if she is likely to suffer much from that complaint. "The Society" was given by the incoming president, Dr. E. F. Armstrong, F. R. S., and son of the medallist of the morning, to which the chairman replied. "The City of Glasgow" was given by Sir William Pope, and it was the most humorous after-dinner talk we have heard in a month of Sundays, with a few extra years thrown in to boot. The Lord Provost replied and Mr. Ninian McWhannell told a story in Scotch dialect which he said he would not make "vera broad"; but for purposes of understanding we need our Scotch dialect narrower. Mr. E. V. Evans, the Treasurer of the Society gave a toast to the Glasgow Section and Mr. J. H. Young, the chairman, responded. Professor G. G. Henderson, Head of the Department of Chemistry at Glasgow University tosated the visitors, and the consulting editor of *Chem. and Met.* replied. Then, with "Auld Lang Syne" the meeting closed.

General Subject Usually Covered in Papers

Thursday began with moving pictures of chemical industries for some and a visit to the harbor for others. A similar informal luncheon at the Grosvenor followed, with Mr. J. Arthur Reavell in the Chair, and in the afternoon the chemical engineering group held a session at which the following papers were presented: "Observations on the Design of Ammoniacal Liquor Stills," by Mr. P. Parrish and "Tar Distillation," by Mr. W. A. Walmsley. In the evening Prof. J. W. Hinchley discussed the general theory of evaporation and Mr. T. H. Gray glycerine distillation. These very interesting papers are presented in abstracted form in the following pages.

The so-called chemical engineering group is an active association within the body of the Society of Chemical Industry. At these meetings upward of two hundred were present, and the business was handled with consummate skill. They are organized to cover a general subject, as in the present instance, evaporation and distillation. A chairman is selected who is specially familiar with the matter under discussion and after a paper has been presented he knows his audience well enough to call on the right people. They ask questions with delightful frankness and are not afraid to express their opinions. There is hardly a dull minute at their sessions.

Technical Program

A Rapid and Accurate Method for the Calculation of Storage Tanks

By J. W. McDavid, D.Sc., F.I.C.

The volume of storage kettles are usually determined either by measuring the vessel and calculating the volume, or by filling the vessel with water and weighing the water as it is run out of the tank. The first method is accurate only for symmetrical tanks of constant vertical cross section. The second method is extremely cumbersome. Still another method is to fill a tank with water and add a weighed quantity of non-soluble salts. The resulting solution is analyzed and the volume calculated in this way. This becomes very laborious if the volume per inch is desired. Another

method has been worked out by J. M. Weir, N. Taylor and the author, which consisted of the following items shown in Fig. 1. A small cylindrical vessel (*A*) 4 inches in diameter and about 2 feet 1½ inches in length is open at the top and is held in a vertical position by means of three legs (*B*), each of which carries a leveling screw (*C*). A plumb line is provided to insure that the apparatus is set vertically. Water is supplied to the apparatus through the ¾-inch inlet cock *D* to which a hose pipe can be attached. *E* is a brass overflow pipe ¾-inch in diameter while *F*, a pipe of similar size, delivers the water to the tank to be calibrated.

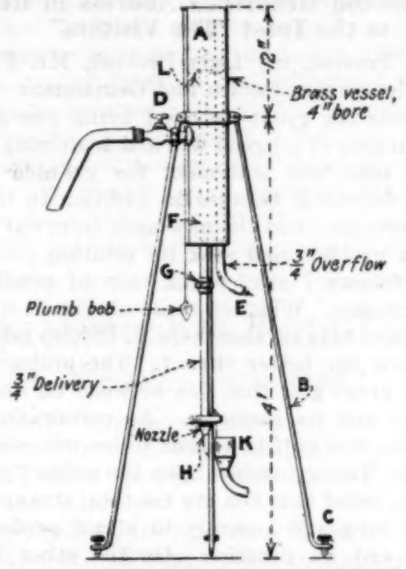


FIG. 1—APPARATUS FOR CALIBRATION OF TANKS

In the first instrument this pipe was for convenience made in two parts connected by means of a screw coupling. In later instruments this coupling was omitted. The bottom of the delivery pipe is fitted with a screw thread, so as to take a nozzle *H*. Five nozzles of diameter ¼-, ⅜-, ½-, ⅝-, ¾-in. respectively were provided so that the quantity of water delivered to the tank can be varied. The funnel *K* works on a swivel so that it can be placed underneath a nozzle and so divert the water from the tank which is being calibrated. *L* is a plate perforated with holes ⅛-inch in diameter and serves the double purpose of forming a support for the pipe *E* and *F*, at the same time reducing turbulence in the surface of the water. The complete apparatus weighs only 26 lb. and can therefore be easily carried about from place to place by one person.

Method of Using the Apparatus

The method of using the apparatus is as follows: The instrument is set up in a vertical position over a convenient inlet hose over the vessel to be calibrated. The funnel *K* is placed under the nozzle, and sufficient water let into the apparatus through the cock *D* until there is a slight trickle of water escaping over the overflow pipe *E*. In the experiment carried out to calibrate the apparatus the quantity of water escaping over the overflow pipe was determined and averaged 0.7 to 1.5 lb. per minute. As soon as water is leaving the water pipe at the rate mentioned above, the head of water in the overflow pipe has reached a constant figure. So long as a level is maintained, the quantity of water delivered through the nozzle with be constant. When this condition has been obtained the funnel *K* is drawn smartly from below the nozzle and the water is allowed to flow into the tank. At the same time a reliable stop watch is started. If it is required merely to find the total volume of tank the time taken to fill it with water is noted. But if it is required to find the volume per inch of depth, then funnel *K* is placed beneath the nozzle after a definite interval of time and the depth of water in the tank measured. By choosing suitable intervals of time, the volume per inch of depth can be calculated.

The apparatus must be calibrated with each of the five nozzles in turn by allowing the water to flow through them into a tared box on a weighing machine. The results obtained in this manner were found to agree well within any possible limit of experimental accuracy and the apparatus has been used with great success in the plant.

The General Problem of Evaporation

By Prof. J. W. Hinchley, A.R.S.M., F.I.C.

A thoughtful paper on this subject, which is divided into two main parts, first evaporation at temperatures below the boiling point and second evaporation at boiling temperatures! Most of Prof. Hinchley's work has been done on evaporation below boiling temperatures and some interesting formulas and curves are presented. This work is also of interest in studying evaporator design, inasmuch as the rate of evaporation from surfaces of various kinds plays an important part in evaporator design. Prof. Hinchley has shown that convex surfaces give a higher rate of evaporation than concave. Considerable work has also been done by Carrier in America and by Dr. Leonard Hill. The effect of velocity of gas stream is also discussed and many practical applications are pointed out as the result of this study. A discussion of vapor pressure and measurement and also of drying immediately precedes the part of the article dealing with boiling point evaporation. This discussion is very interesting and takes up the variation in the rate of heat transmission and in evaporator design. He refers to the work of Badger and others in American universities on the variations of heat-transmission from steam to boiling liquid.

Design of Ammoniacal Liquor Stills

By P. Parrish, A.I.C.

The paper does not deal with the merits or demerits of the batch-fired intermittant stills, or the distillation of ammoniacal liquors. It assumes that substantial technical reasons justify the abandonment of such plants. The present type of continuous columnar still for distillation of gas liquors can be traced to a Frenchman by the name of Savalle, who was responsible for many patents in 1875 aimed at improving the apparatus and processes for the distillation and purification and rectification of alcohol. Savalle's work was undoubtedly directed at the improvement of the Coffey still and it is interesting to note that this alcohol still was substantially taken over into the ammonia industry and used in that work. Mr. Parrish then divides the ammonia stills into three categories, distinguished by a different arrangement of the free still, the lining chamber and the fixed still. He discusses the relative advantages of these arrangements and then enters into

a detailed and very thorough discussion of the construction of stills. Finally the operating details which are necessary in continuous distillation are considered. The whole paper makes very formidable and worthwhile reading.

Tar Distillation

By W. A. Walmsley

This, as well as the last paper, originated in the Provan Chemical Works at Glasgow. Mr. Walmsley divides tar distillation into its constituent parts discussing first the variation in tar which resulted from the use of vertical retorts. The treatment of the various fractions is undertaken in detail and among other things the complete description of the Dorr continuous causticizing plant which is in use there. Some details as to the operation of continuous tar stills are given, tar being distilled over a period of 5 days, in the longer experiments. Final paragraphs deal with the benzol plants and the Kubierschky spraying.

Historical Development of the Distillation of Glycerine

By C. H. Gray

From the earliest mention of glycerine as "the sweet principle of fats", by Scheele, in 1779, through Cheveruel's classic researches about 1820, until Cap's process was introduced in 1840, very little commercial use was made of glycerine. Cap used the liquor from lime saponification of tallow in candle manufacture. After appropriate treatment, the neutralized liquor was carefully evaporated, then passed through bone charcoal, which gave a more or less pure glycerine. Later improvements by Tilghmann and Wilson made considerable difference in the process. Perhaps O'Farrell's improvement, in 1881, is of sufficient importance to mention. He used vacuum pumps for distillation, together with steam at 200 deg. C., using soap lye crude in the still. This lye was, no doubt, substantially soap crude, as we know it today, except for purity. Considerable improvement in design of apparatus was made following 1880, notable improvements by Van Ruymbeke in 1895, and by Scott. Both of them employed extremely high vacuums, as high as 28 in., and many other improvements, such as surface condensers etc.

Double and triple distillation of glycerine did not come about until recently, in order to attain high purity required by the British Pharmacopoeia. Garrigues, in 1905, and Wood, in 1907, bring the subject almost down to the most modern type of plant. Broadly speaking, we may summarize the progress made in glycerine distillation as having gone along the following lines: (1) By actual improvement in design of apparatus from an engineering standpoint. (2) Glycerine of today is practically a pure substance in so far as commercial material may be free today as distinct from earlier times. (3) Efficiency and economical use of energy are the points aimed at by our chemical engineers and designers. It is interesting to note that Lieutenant-Colonel Briggs, B.S.O., in his chapter on glycerine distillation in Young's latest volume "Distillation Principles and Processes" gives the following figures for relative coal efficiencies per ton of glycerine distilled:

Wood	13
Scott	14
Van Ruymbeke	16

As the final development in glycerine distillation, we may briefly consider the idea propounded by Société Francaise de Glycerines. This plant is so designed as to work without the use of steam. Crude glycerine at a temperature of 180 deg. C. passed in an atomized state from one vessel by means of suitable jets to another vessel. Steam coils maintain the temperature at 180 deg. C.

We have no practical details at this time, but it is evident that the idea is very unique, although at times there are some obvious troubles involved. For instance, choking of jets, removal of solids, residues etc.

Dr. Ellwood Hendrick's Address in Reply to the Toast "The Visitors"

My Lord Provost, my Lady Provost, Mr. President, Professor Henderson, Ladies and Gentlemen:

From across the great waters I bring you greetings and the assurance of all good will and fraternity. I shall ask you to take this statement for granted and the message as delivered, because in addition to the felicitations of ceremony and the messages from our hearts I bring also a problem and seek its solution.

In what follows I shall speak only of conditions in the United States. Whether these obtain in similar or in less measure here or elsewhere in British possessions you will know far better than I. The problem has to do with the great gulf that lies between the profession of chemistry and its business. As corporations grow in magnitude, this gulf threatens to become even wider, and since Mr. Young touched upon the subject yesterday I venture the belief that you are not total strangers to it.

We study long and ardently to attain proficiency in the science and its practice. On the other hand, no study, no proficiency, no competency, and sometimes not even character, is demanded of him who would engage in the business of chemistry. So long as he can offer or borrow money he is welcome. This is because the need of chemical development is so urgent for the welfare of every industrial nation that we do not dare place hindrances in the way of it. The situation provides, however, that the business end rules the professional end. Business directs the profession in its own field and the profession must obey. This is not true of all chemical enterprises by any means but it occurs so frequently that ignorance of the science controls, rules, or directs chemical practice, that I venture the general statement that in the United States the weakness of chemical industry is not in the works, or in equipment, or in labor, or in engineering skill, or in the chemists themselves, but that it rests in the boards of directors of chemical establishments.

Corporations have an unfortunate habit of what we call window-dressing, in which men who have achieved success in any walk of life are supposed to assure it also in chemical industry, so that a successful banker, stockbroker, lumber merchant, mine owner and what-not are invited to join the board in the belief that the public will follow the mistaken idea that astuteness will conquer in spite of ignorance.

In no other great profession than ours does this situation exist. Imagine, if you will, a sick man sending for a physician and on his arrival demanding that he punch a time clock, coming and going, be paid according to the time spent in making his diagnosis, and that he devise treatment according to the patient's whim and desire. Or of a client insisting that his counsellor at law shall construe the law according to his wish and not as it is found.

The control of chemistry by business has reached such a pass that I have known a speculator in the industry to destroy the entire research organization of a great establishment engaged in the most difficult and involved scientific processes and to consult an excavation engineer for enlightenment as to how the works should be operated.

The future of the industrial nations rests with their chemists. According as they are more or less men of wisdom and understanding, and above all things men of character, industry will flourish or fade away. We cannot ask for all of these standards from the man who represents the investment of capital alone.

Now the last thing we want to do is to restrict the rights of property, or to destroy initiative. But chemical industry is a professional institution and it cannot flourish if it is ignorantly directed. Chemical vision and understanding are required of it if it is to prosper. And the looting of corporations by cutting off necessary expenditures for research and technological development to use such funds for dividends, or to make a brave showing for the market manipulation of shares, is so heinous an offence against the general welfare that no self-respecting chemist should countenance it or endure participation in it.

Before anyone is admitted to the practice of medicine it is required of him that he take a solemn oath to devote himself to human welfare. A solemn oath of allegiance to the principles of right is required of everyone who would practice at law. At present chemists pass examinations—and look for a job. This does not meet with the great obligations of our profession. So, as a possible means to secure a better status for the profession of chemistry in its own affairs, I venture to suggest that an Oath of Science be drawn and administered to everyone who would engage in chemical practice. He should bind himself on honor to seek diligently the truth by the right co-ordination of all facts which alone leads to it, to abstain from all knavery under any and all conditions, and to address himself to the welfare of humanity, striving throughout his days to seek the light of greater understanding and to bring about a larger, a better, and more abundant life for all mankind.

Calcium Arsenate Manufacture

By Howard W. Ambruster

THE suddenly developed and more or less acute shortage of calcium arsenate available for the battle with the boll weevil in the South has intensified the interest in this product.

The market record of this insecticide has been so erratic in the past that despite all indications months ago, of an increasingly heavy infestation and consequent demand, the manufacturers refused to accumulate any stocks in anticipation of the season's requirements and waited until there was an actual movement by sale or contract of the several thousand tons carried over from 1920 and 1921.

The bulk of these stocks had the status of a distressed merchandise and were sold in the early months of this season at a price considerably under the actual cost of production during the high level of the inflation period. This assisted in completely demoralizing the market as far as current production was concerned and it was not until the last few weeks that it was generally realized that all old stock would be absorbed and still permit active demand for any additional tonnage the existing plants could turn out during the balance of the season.

Indications are now that dusting for boll weevil control will continue well into September, thus compelling the manufacturers to operate their plants to full capacity during the hottest months of the year.

The Same Old Story in Insecticides

It is the old story in the insecticide industry—a feast or a famine year after year; high surplus stocks to carry over and liquidate on a declining arsenic market; or a sales department weeping and gnashing its teeth at the necessity of declining a flood of last moment orders at high prices, an account of earlier commitments at selling prices that preclude any profit.

As an insecticide, however, calcium arsenate is in a class by itself as it promises a real tonnage development and as the natural consequence of this season's dramatic climax, plans for additional plant facilities are now under consideration among all existing manufacturers and many localities in the South are discussing ways and means of building calcium arsenate factories and taking care of their local requirements for next season.

Consideration of additional plant facilities must be based generally on the usual chemical process of utilizing commercial byproduct white arsenic oxidized with nitric acid and combined with lime. The possible production of calcium arsenate direct from an arsenical ore must be considered as having a bearing on the subject but in view of the recent excitement in the South due to the short supply this season, the future development of this new chemical process will hardly prevent others from increasing old plants and building new ones in anticipation of next season's demand for calcium.

The Executive's Dilemma

For the manufacturer who has been in the insecticide business and has any perspective on its many problems, the picture at this time presents many of the aspects of a seven-ring circus. He does not dare concentrate his gaze on only one part of the performance and his vision is confused as he tries to take it all in at once. He knows that it is a slippery hill, but he is bound to try and climb it. For the newcomer in the field the problem may appear much simpler and the hill not slippery at all. All that seems necessary is to raise a little capital, build a plant, buy some lime and arsenic, and when next season's bugs appear there will be a new local hero. But the problem is not so elementary as all that by any means.

There is no question, however, that there is room for a considerable increase in the production of this material and that unlike most of the orchard and truck sprays, calcium arsenate is coming into its own as a tonnage proposition. The existing plants where it is now made, or can be made, have nearly all developed from small units for the production of miscellaneous arsenical and other spray materials such as paris green, london purple, lead arsenate, bordeaux mixtures, etc.

Early Calcium Arsenate Plants

Calcium arsenate was first made in comparatively recent years, along with other similar products as the insecticite manufacturers decided to add it to their line

and few radical changes were introduced from earlier equipment or methods for arsenical compounds. The first of the arsenical sprays to be made on any basis of quantity in this country—paris green—was originally included with the pigment colors and small earthenware units for the oxidation of white arsenic to make the necessary arsenic acid, were added later for the production of lead arsenate.

Recent Developments

In the last few years, two important and somewhat radical improvements have been developed in insecticide manufacture, one in the acid production and the other in reducing the wet batch of lead or carcium arsenate to a commercial dry powder.

The majority of the arsenic acid plants as stated above were of earthenware construction, comparatively small pots in which the commercial white arsenic is oxidized with nitric acid and a part of the nitric fumes recovered in an earthenware tower or series of towers, to be utilized again with subsequent batches of arsenic.

A great deal of hand labor is required for the operation of these plants. The arsenic must be fed by hand in small quantities; such stirring as the batch gets is by hand and the sludge or residue removed by hand after the finished acid is syphoned out of the pot or generator. The breakage item is a heavy one and adds materially to the cost of the acid. The quality of the white arsenic always varies somewhat and thus affects the recovery of the nitric acid by inducing an erratic and explosive reaction which is accentuated by the irregular hand feeding. This results in sudden bursts of gas which the suction from the recovery towers cannot handle.

High Silica Iron Aids Arsenic Acid Process

Preceding and during the war period, the use of high silica iron for large nitrating kettles was developed and large units of this material were adapted for arsenic acid manufacture. This has made it possible to produce the material in very much large batches and to introduce mechanical feeding of the arsenic itself, mechanical stirring of the batch and dropping the finished acid with the sludge or residue from the bottom of the kettle to a shallow tank where the sludge is settled out and the acid pumped to storage or insecticide units. The economy of both labor and nitric recovery are considerable and the production of a nitric-free arsenic acid which can be safely shipped in steel tank cars was first made commercially feasible by this method.

Another radical departure which is applied to advantage in large arsenic acid units is the substitution of the acidproof brick masonry nitric acid recovery tower for the round terra cotta-tile tower construction. The brick tower is hardly to be considered for a small unit but for anything over the production of a few tons of arsenic acid per day, its advantages of stability and efficiency must be given consideration.

In the production of the insecticides themselves, the usual process necessitates the large tubs with mechanical stirring apparatus in which the finished product is combined in a very dilute suspension. The size and material of the tubs and the methods of handling the various raw materials may vary somewhat but the essential features must remain the same.

The New Drum Drier

Beyond these mixing or striking tubs, however, the other definite step forward has been taken in the substitution of a specially designed atmospheric drum drier for the filter presses and hot stoves, oven or tunnel driers of the old fashioned pigment plants. We must go back here to the brick ovens filled with steam pipes of the European color plants and their successors, the modern hot air tray driers in which the filter press cake is baked until the last drop of moisture in the center of the cake is evaporated. For many products these modern driers scientifically designed and properly operated are still the most efficient units available. But for products like lead and calcium arsenate which are beginning to be handled on a tonnage basis the labor saving affected by means of the atmospheric drum drier is a very large item in proportion to the total labor cost of the material.

Economy of Drum Drier

Instead of pumping the batch first to a filter press and then handling the cake on trays first in and then out of the drier, the liquor is simply pumped to the drum drier, where it is picked up from a trough on the surfaces of the hot cylinder and the water is evaporated by the time it reaches the scraping knife on the lower downward turn of the drum. The product comes off in a fine flake which requires very little grinding as compared with filter press cake dried in a tray drier and a power saving also results at the grinding mill. The question will naturally be raised as to the amount of steam required for the drum drier to evaporate the entire moisture content of the batch, whereas in the older method a definite percentage of the water is removed at the filter press. Experience with the arsenates has demonstrate, however, that the greater efficiency of the effective heat units as applied to a thin film of liquor on the drum rather than as a hot blast forced through and around a filter press cake results in no greater coal and steam consumption for an equal amount of dry production, and in some instances an actual coal saving is found.

Importance of Improved Methods

The writer was fortunately in a position to observe these various methods of arsenic acid and insecticide production in the same plant, having supervised the actual construction and operation of both the older and the newer types of units and the comparative results were so conclusive that the advantages set forth above must be accepted as demonstrated facts. The quality of both the arsenic acid and the finished insecticide was improved, if anything and the material and labor saving constituted a tremendous item in proportion to total cost. Chemical manufacturers are frequently loath to throw out existing units before the scrap heap claims them but the controversy regarding these improvements in the production of arsenicals bids fair to be settled in the immediate future with the enlargement of existing plants and the construction of new ones for the struggle against the future progeny of the 1922 boll weevil. There can be a variable cost factor of several cents a pound on a half-pound package of orchard- or garden-spray and the salesmanship or good will of the manufacturer will get or hold the customer. But boll weevil marches in the millions of modern warfare and from the chemical manufacturers' standpoint, this pest must be fought on a carload basis where a difference of a few dollars a ton will decide each producers' part in the contest.

The Technology of the Carbon-Electrode Industry—II
Raw Materials for Electrode Manufacture

The Physical and Chemical Properties of the Carbonaceous Substances and Binding Materials Are Reviewed From the Standpoint of Electrode Requirements—Petroleum Coke and Pitch Are the Principal Raw Materials for the Carbon Industry*

By Charles L. Mantell
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As a carbon electrode consists almost entirely of elemental carbon, it naturally follows that the best starting point for its manufacture would be a material which contained the largest possible amount of carbon. A raw material would be desired which consisted almost entirely of carbon. This condition is satisfied by those bodies which are known under the general name of carbonaceous substances and, as a matter of fact, practically all carbonaceous matters are, or have been, used in the manufacture of electrodes.

Electrode Requirements

Before attempting a detailed description of the various raw materials, it may be well at this point to devote brief attention to the characteristics and desired qualities of the finished electrodes in order that the raw-materials requirements may be better understood.

In general commercial electrodes consist of elemental carbon, contaminated with more or less ash depending upon the raw material used in making the electrode. The ash is composed of the oxides of silicon, iron, aluminum, calcium and in some cases of copper. The resistivity—i.e., specific electrical resistance—expressed in ohms per inch cube, varies with the ash content; the higher the ash percentage the greater the resistivity, other factors remaining unchanged.

Electrodes for electrothermic work usually have high resistivity. They serve as refractory conductors of the electric current and do not enter into the reactions taking place in the electric furnace or other apparatus in which they are used. The manufacture of calcium carbide is an example of an electrothermic requirement. In this case the raw materials are coke and burnt lime. These are cheap and impure, for the coke contains a large amount of ash. It does no harm, therefore, to use an electrode high in ash in the furnace, for the additional amount resulting from the consumption of the electrode would probably be decomposed by the heat of the furnace itself. Electric steel or electric-furnace alloys are other examples. In these, contamination from the electrode would be drained out of the furnace with the slag or dross and would not get into the product. In most cases of the electrothermic use of carbons, the impurities of the electrode either do not get into the product of the furnace, or if they do, make no appreciable difference in the product. Thus a satisfactory electrode for electrothermic purposes may be high in ash, since its resistivity is either unimportant or else can be sacrificed if, by so doing, a cheaper electrode may be employed.

In electrolytic work, however, the purity and resistivity of the carbons are important considerations. Smaller currents are used at much lower voltages, so that high resistivity means a greater power loss than in electrothermic work. Furthermore, the material of the electrode may enter into the reaction and its impurities be imparted to the product of the electrolysis. An example is the reduction of alumina to aluminum. In this case the impurities of the electrode, if present in too great amounts, cause serious contamination of the aluminum metal. Silicon and iron are particularly undesirable. It is desired that carbons for electrolytic use have a low resistivity and be as free as possible from contamination.

Classification of Raw Materials

Raw materials for carbon-electrode manufacture may be divided into three classes according to the part they play in the process: (1) "Body" materials, which are the carbonaceous matters making up the bulk of the finished electrode. (2) Binders, which serve to hold together the finely ground particles of the body materials, and (3) other miscellaneous substances entering into the manufacturing process.

TABLE I—A COMPARISON OF CARBONACEOUS SUBSTANCES USED AS BODY MATERIALS IN ELECTRODE MANUFACTURE

Material	Moisture, Per Cent	Volatile Matter, Per Cent	Fixed Carbon, Per Cent	Ash, Per Cent	Specific Gravity
Coal:					
Anthracite	2.4–14.0	1.5– 8.5	65.0–85.0	6.0–18.0	1.5
Bituminous	1.8–19.0	6.0–40.0	49.0–79.0	2.8–19.0	1.36
Coke:					
Beehive	0.5– 1.5	0.3– 3.0	80.0–95.0	4.0–21.0	1.9
Byproduct	0.7– 3.0	0.6– 3.3	79.0–92.0	7.0–16.0	1.7
Petroleum coke	0.4– 2.0	4.0–18.0	82.0–97.0	0.5– 2.0	1.8
Retort and gas carbon	0.5– 2.0	4.0–13.0	88.0–97.0	3.0–10.0	....
Graphite, natural	0.5– 2.0	1.0– 7.3	78.0–92.0	7.5–19.7	2.0– 2.5
Pitch coke	0.5– 1.5	4.0–12.0	85.0–97.0	0.3– 2.0	1.6– 1.8
Wood charcoal	1.0–10.0	1.0–10.0	84.0–97.0	1.0– 4.0	....
Lampblack	0.6– 3.0	3.0– 7.0	90.0–96.0	0.6–10.0	....
Butts, amorphous, from electrothermic work	0.2– 2.0	0.0– 0.2	85.0–94.0	6.0–14.0	1.9– 2.2

The composition of the various body materials which are, or have been, used in the production of carbon electrodes is shown in Table I.

The Body Materials

Anthracite and Bituminous Coal

Anthracite coal contains a large amount of fixed carbon as compared with its content of volatile matter. The ash is incombustible mineral matter, consisting mostly of clay, silt or sand, more or less intimately mixed in the body of the coal. Anthracite is used largely for electric-furnace electrodes where purity and low resistivity are not desired. In fact, very little else

*Part I of this series, which reviewed the history of the industry, appeared in *Chem. & Met. Eng.*, vol. 27, No. 3, July 19, 1922.

other than anthracite coal is used in making the large-sized molded electrodes for electric furnaces.

Jean Escard[12] gives the following data in regard to European practice in the purification of anthracite for use in making electrodes for the reduction of aluminum. "Anthracite in general contains more than 2 per cent of ash, of which at least 0.35 per cent is silica. This latter figure is inadmissibly high for the production of aluminum, but when purified such anthracite shows the following ash figure before and after treatment (anthracite is first degassed in one of the standard illuminating gas ovens, the gas being burned under the grate):

	— Scotch Anthracite —		— Welsh Anthracite —	
Constituents of Ash	Previous to Treatment, Per Cent	After Treatment, Per Cent	Previous to Treatment, Per Cent	After Treatment, Per Cent
SiO_2	5.00	0.84	0.78	0.20
Iron oxides	1.06	0.25	0.32	0.12
Al_2O_3	2.02	0.25	0.43	0.12
CaO and MgO	1.16	0.20	0.53	0.13
Total	9.24	1.30	2.06	0.57

The chemical treatment referred to by Escard consists of digesting the ground anthracite in a hot concentrated NaOH solution, and following this with a washing with a more dilute solution.

In the United States a much purer raw material can be obtained at a lower price than the cost of the purified anthracite would be, so that this method of purification is not used. In this country petroleum coke is the chief raw material for graphite electrodes which are made by graphitizing in the electric furnace.

Bituminous coal is high in volatile matter, containing a much smaller amount of fixed carbon in proportion to the volatile matter than the anthracite. It also runs high in ash. Since large losses are sustained in driving off the volatile matter in calcination and since the gases generated cannot usually be profitably disposed of by an electrode plant, bituminous coal is seldom used as a raw material. It has the further disadvantage of having a lower specific gravity than anthracite. Some of the first electrodes made for metallurgical work were prepared from a mixture of bituminous and anthracite coal, but the practice has since been abandoned.

Coke prepared from bituminous coal is high in ash content, high in fixed carbon and low in moisture and volatile matter. It is used in Europe for electrodes for electrosmelting, but to a much less extent in the United States. Coke is not employed in making electrolytic carbons.

Petroleum Coke

Petroleum coke, the residue in the distillation of petroleum oil by the intermittent process, is the most important material for electrode making. It is a hard and brittle substance, of shiny, oily appearance, is very high in fixed carbon and low in ash. It is one of the purest forms of carbon available in large quantities. Its ash is probably due to the small amount of fine sand carried along mechanically or in suspension by the crude oil. The coke represents approximately 1 per cent of the original oil and from 8 to 9 per cent of the weight of the final residual tars after all of the other fractions have been distilled.

Sulphur is one of the undesirable constituents of petroleum coke, and is greater in coke from Mexican crude oils than from those obtained from other fields.

[12] *General Electric Review*, Schenectady, N. Y., November-December, 1918.

Not many years ago petroleum coke was merely a byproduct—if not a waste—in the oil industry, and was disposed of by burning it under the stills. In recent years, however, the market price has nearly trebled, and today the petroleum refinery regards it as a valuable commercial material. The quantity of petroleum coke being produced is growing smaller, however, because many oil distillers are changing over from intermittent to continuous or vacuum methods whereby no coke is produced. This change is already causing electrode manufacturers to search the field for new sources for their raw material supplies.

The percentage of volatile matter in petroleum coke depends upon the temperatures reached in distillation. Present practice is to run the stills to as high a temperature as possible without actually damaging the bottoms of the stills. Pyrometric control methods are not used nor is any attempt made to control the percentage of volatile matter in the coke produced.

After the run is finished, the still is allowed to cool for 4 to 6 hours. Workmen then enter through the manhole, their hands, head and feet wrapped in wet cloths, break off the coke with heavy iron bars from the sides and bottom of the still box, and unload it. Because of the excessive heat, the men can remain inside the still for only a short while. The coke is cooled by drenching with a stream of water.

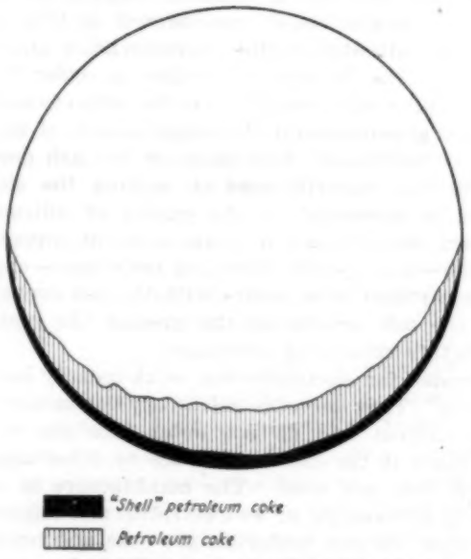


FIG. 1—SECTIONAL ELEVATION OF AN INTERMITTENT-TYPE OIL STILL, SHOWING COKE FORMATION

Petroleum coke is received at the electrode plant in pieces varying in size from as small as 3 in. in diameter to chunks three or four times as large as a man's head. The coke consists of two portions, the main or upper part and beneath it a layer of denser material, called "shell," varying from eggshell thickness in some pieces to 2 to 3 in. This shell is the coke that was in contact with the sides and bottom of the still (see Fig. 1). It is higher in ash and soluble salt than is the coke of the upper portion, probably because the mineral matter of the oil gradually sank to the bottom of the still as the distillation proceeded and the shell, being the first coke made, formed around the mineral matter. Being nearer the source of heat and the bottom of the still, the shell was heated to a higher temperature and lost more of its volatile matter than did the upper portion.

Shell petroleum coke usually contains from 1 to 3 per cent of soluble salts, mostly sodium chloride. When coke containing shell is calcined in silica brick-lined retorts, the salts are volatilized and attack the brickwork by forming low-fusing sodium silicates. In order to save the retorts and lengthen their life, the shell is chipped off and separated from the main portion of the coke, to be calcined in special calciners by itself. The oil distillers formerly prepared coke in this manner, but in recent years have refused to ship anything but unchipped coke, as the cost and trouble of chipping was not justified by the price they received for the material.

A short time ago a manufacturer of carbon brushes was in the market for 25 to 30 tons of petroleum coke, and on attempting to obtain this amount from the oil distillers learned that they had none for sale. Their output in its entirety had been contracted for a year in advance by electrode makers. The contracts of one of the largest electrode plants called for the delivery of approximately 50,000 tons of petroleum coke during the year. This amount is the result of the distillation of 5,000,000 tons, or 31,250,000 bbl. of crude oil.

Petroleum coke is used more than any other material in making the purest electrolytic carbons. These electrodes are low in ash and low in resistivity. For the lower grades, where exceptional purity is unnecessary, petroleum coke is mixed with anthracite. This enables the manufacturer to turn out a cheaper electrode but of purer composition than if he had used anthracite alone.

Retort and Gas Carbon

Retort carbon, or "glance" coal, is a very dense form of carbon, produced by the deposition of carbon in the upper part of the retorts in the manufacture of coal gas. It exhibits the luster of a metal, is sonorous when struck and is a good conductor. Ordinarily it is rich in silica, the result of adhering fragments of brickwork and refractory pastes from the retorts. The amount of retort carbon on the market, however, is very small. Three years ago a canvass of several hundred gas-manufacturing plants in the East was made to determine the amount of this material available. Quantities ranging from 1 to 25 tons per year were offered—this being the entire production of the individual gas works—at prices from $20 to $30 per ton. For most of the gas makers, the price received for the material would not have paid them for their trouble in accumulating it from the periodical cleaning of the retorts. The price asked was considerably higher than the market price of petroleum coke, a much purer substance.

Because of the difficulty of obtaining large quantities as well as its high price, retort carbon is seldom used in making electrodes. It finds its greatest use in the manufacture of carbon brushes, where its hardness and the sharp edges of its particles are employed to give a cutting grain to the texture of the brush.

Other Body Materials

Graphite. Graphite, of the natural variety, is not employed in the United States for the manufacture of electrodes, first, because of its high price ($120 to $180 per ton) and, second, because the artificial product, made directly by graphitizing electrodes in electric furnaces, as a result of its superior qualities, is given preference in practice.

Pitch Coke. Pitch coke has much the same qualities as petroleum coke. It is produced as a result of the destructive distillation of pitch, which comes mostly from coal tar. It is low in ash and high in fixed carbon. At the present time it is not being produced in large quantities. Its production, however, is gradually increasing with the demand. In every place in which petroleum coke is now used it can be replaced by pitch coke. As the supply of petroleum coke grows less, due to the changed methods of oil distillation, its place will probably be filled by pitch coke. What is needed is the production of a pitch coke with a volatile matter so low (0.5 per cent) that it needs no calcination to prepare it for use in electrode making. This has been done, but not as yet on a commercial scale.

Wood Charcoal and Lampblack. These substances were used by some of the earlier investigators. They are low in ash and high in fixed carbon. Their high price, however, and the fact that they are produced in relatively small quantities prevent their utilization in electrode making.

Butts. Butts are the unconsumed or waste portions of finished electrodes. They are usually high in ash. They are used in making electrothermic carbons, and are mixed in low percentages with petroleum coke for electrolytic electrodes. Usually, however, they are given a preliminary purification. As they are portions of electrodes previously baked, they need no calcining operation to prepare them for use.

TABLE II—COMPARISON OF APPROXIMATE PRICES OF CARBONACEOUS MATERIALS, f.o.b. NEW YORK (1922)

Materials	Dollars Per Ton
Coal:	
Anthracite	8.00@ 9.00
Bituminous	3.50@ 4.00
Coke:	
Beehive	5.50@ 6.00
Byproduct	4.50@ 5.50
Petroleum coke	12.00@ 15.00
Retort carbon	25.00@ 30.00
Graphite	120.00@180.00
Pitch coke	Not on open market
Butts	20.00@ 40.00

A rough comparison of prices for the most important carbonaceous materials which are or may be used in electrode manufacture is afforded by Table II.

Binding Materials

Binders for electrode making are divided into three classes; those which at ordinary temperatures are either (1) liquid, (2) semi-solid and (3) solid. The principal binding materials which have been used in the manufacture of carbon electrodes are:

(1) Liquid:
  (*a*) Tars.
    (1) Retort-gas tar.
    (2) Oven-gas tar.
    (3) Water-gas tar.
(2) Semi-solid:
  (*a*) Electrolytic pitch.
(3) Solid:
  (*a*) Coal-tar pitch.

Chemical analyses of these substances are given in Table III.

The binders used are, in general, products of the distillation of coal. They are composed of elemental carbon and hydrocarbons in varying proportions. Their function is to hold together the finely ground particles of the body materials. Since the volatile matter of a binder is driven off in baking, the best binder, from the standpoint of the finished electrode, would be the one

TABLE III—CHEMICAL ANALYSES OF BINDERS USED IN ELECTRODE MANUFACTURE

Material	Melting Point, Deg. C.	Viscosity (MacMichael) (Seconds Per 100 Revolutions)	Free Carbon, Per Cent	Coking Value, Per Cent	Softening Point, Deg. C.
Coal tar	Liquid	3–15	7–25	10–30	.....
Retort gas tar	Liquid	5–30	20–40	40–65	.....
Oven gas tar	Liquid	3–15	12–20	15–30	.....
Water-gas tar	Liquid	3– 8	2– 5	10–20	.....
Pintsch or oil-gas tar	Liquid		25–30	25–35	.....
Electrolytic pitch	Semi-solid	3–25	15–25	20–35	20
Pitch:					
Soft	50–70	3–35	15–25	20–35	35–60
Medium	70–90	15–40	25–35	30–40	50–80
Hard	90–140	20–250	30–50	35–55	80–115

that had the highest coking value; or, in other words, loses as little as possible during calcining.

The earlier investigators used many different viscous matters to hold together their carbonaceous materials. These included caramelized sugar, sirups, molasses, resins, turpentine and various products from the distillation of organic substances.

Viscosity is more or less a measure of the binding power of a material. Viscosities are not absolute figures (unless absolute viscosities are used, reported in dynes per centimeter) and serve only as comparisons, one to the other. A binder with a high viscosity will tend to have a greater cohering power than one with a low viscosity. In measuring viscosity, either the Sturner, also known as the MacMichael, or the Engler types of instrument are most commonly used.

TARS

Coal Tar. This material is too well known to require any extensive description of its properties. It is a black, viscous liquid, composed largely of hydrocarbons, with a low percentage of "free" or elemental carbon. It varies greatly in composition, and may better be classified according to its method of production into retort-gas tar and oven-gas tar. Coal tar used in making electrodes is usually a mixture of tars from different sources. Its viscosity is low; in the case of some thin tars, it can be measured only with difficulty in the MacMichael instrument.

Retort-Gas Tar. This tar is obtained as a condensation product in the hydraulic mains, scrubbers or condensers in the manufacture of coal gas for illuminating purposes. It is less fluid and contains less of the lighter hydrocarbons, more naphthalene, anthracene and their accompanying oils and more free carbon than tars from other sources. The composition varies with the heats and coals employed. In general, the lower the carbonization temperature of any coal the more fluid the tar and the lower its carbon content.

Retort-gas tar contains 20 to 40 per cent of free carbon and yields on distillation from 50 to 75 per cent of pitch, or if the distillation is carried all the way, 45 to 65 per cent of coke.

Oven-Gas Tar. This material is obtained in the distillation of coal in byproduct coke ovens. It is similar to retort-gas tar, except it is more fluid. It contains more of the hydrocarbons and considerably less free carbon, which latter usually runs from 12 to 20 per cent. The composition changes, of course, with the coal, type of oven and the coking temperature.

Water-Gas Tar. The tar obtained from the manufacture of carburetted water gas for illuminating purposes differs mainly from coal tar in the entire absence of tar acids and ammoniacal liquor, and in the small amount of free carbon present, which is usually less than 2 per cent.

Water-gas tar on distillation yields from 35 to 60 per cent of pitch, or, if carried further, 20 to 40 per cent of coke of the weight of the dry tar.

Pintsch or Oil-Gas Tar. This material comes from the manufacture of oil gas used for railway lighting. It is similar to water-gas tar, but contains much larger amounts of free carbon, frequently 25 to 30 per cent or even more.

Coal tar, being usually a mixture of some or all of the above tars in varying proportions, is largely used in the manufacture of molded electrodes where great pressures are required, sometimes running as high as 25,000 lb. to the square inch. Tar is never used alone as a binding material in making extruded carbons, since tar binder mixtures are practically unextrudable. Dehydrated tars, containing less than 0.5 per cent of moisture, are mixed with pitch. Tar is often employed to lower the melting points of pitches, and in small percentages, to give a more plastic mix for extruded electrodes. Where high-density carbons are desired, its low coking value is a disadvantage. Its use produces an electrode high in porosity, since a large proportion of it is volatilized during the baking process.

PITCHES

Electrolytic Pitch. This material is the result of the partial distillation of tar, in which only the lighter fractions are driven off. It is semi-fluid at ordinary temperatures and its properties are intermediate between those of tar and pitch. It is higher in free carbon and has a higher viscosity than tar. For a number of years it was used in some localities for making molded carbons but is no longer produced in large quantities.

Pitch. Pitch is the residue obtained in the distillation of coal tar after all the light oils, intermediate fractions and heavy oils (creosotes, anthracene, etc.) have been distilled.

Pitches may be classified, according to their melting points, into (1) those which at ordinary temperatures are soft and easily melted, (2) those which are midway between soft and hard and (3) those which are hard and require a much greater amount of heat to convert them to a liquid condition. This division is purely arbitrary. Soft pitches run from melting points of 50 to 70 deg. C.; medium from 70 to 90 deg. and hard pitches from this point to 140 deg. or higher. Over a wide range of melting points, the free carbon content and the coking value will increase with the melting point of the pitch. The same holds true for viscosity. Neither of these generalizations applies, however, over small ranges of melting points.

In making extruded electrodes pitches are used as binders, to the exclusion of practically all other substances. They are often employed, in small proportions, to stiffen the mix, especially in making molded carbons with a tar binder.

SELECTION OF PITCH FOR ELECTRODE MANUFACTURE

Pitches are made by three methods of distillation:

(1) Tar is distilled to a hard, "core" pitch of high carbon content and with high melting point (150 deg. C. or higher) and then "cut back" with tar distillates to give a pitch with the required melting point.

(2) Tar is distilled to the required melting point under vacuum by the use of steam in the still. The steam assists in removing the high-boiling oils and helps to prevent the deposition of coke on the sides of the still.

(3) Tar is distilled in direct-fired horizontal stills carrying on the process without steam or vacuum and letting the products of distillation pass off under the pressure at which they were generated.

For extruded electrodes, large-scale experiments have shown that pitches made by the second and third methods are superior to those made by the first. The selection of tar distillates to be used in thinning down pitches, carried to the full limit of distillation (method 1) is especially important, since it has been found that when creosote or naphthalene are employed for this purpose the resulting pitch is lacking in binding power. This defect is obviated only by the use of heavier distillates, such as "green" oils of a more viscous character.

Pitch is normally about two-thirds of the weight of the tar from which it was distilled. Its physical character is mainly dependent upon the temperature employed in distillation, but its ultimate chemical analysis is governed by the tars used in its manufacture and the quality and composition of the coal from which the tars were produced.

About the only other material entering into carbon making is so-called "summer" oil. This is a crude petroleum oil from which the lighter fractions have been distilled. Since it produces a more plastic mix it is often used as constituent of the mix for extruded carbons in order to cut down the pressure necessary for extrusion. It has no binding properties. When it is used it cuts back the pitch and lessens its binding power.

Handling and Storage of Materials

The carbonaceous materials are received at the plant in gondolas and are usually unloaded into track hoppers, which in turn are emptied by pan conveyors. Coal is purchased in run-of-mine size, petroleum coke just as it was broken out of the still, and butts as they were produced in the electrode-consuming processes. The materials are given a preliminary crushing in jaw or roll crushers to a 3-in. size and either carried direct to the calcining operations or are placed in storage.

Tars are usually stored in underground tanks, to which they can be unloaded from tank cars. The same holds true for summer oil. Pitch is commonly shipped in box cars. It is in the sizes in which it was removed from the stills and must be given a preliminary crushing in a roll or gyratory crusher.

Materials as received are sampled for chemical analysis and these are prepared for the laboratory by the methods of the Bureau of Mines.[13] The carbonaceous substances are analyzed for moisture, volatile matter and ash, if they are to be used for electrothermic carbons; and in addition, for iron and silicon if employed for electrolytic electrodes. Binding materials are tested for melting, and softening points if they are solid; viscosity, free carbon, and coking value. The analytical procedures in the case of the tars may be found in any standard handbook on this subject.[14]

The third article of this series will appear in a subsequent issue and will discuss the calcining operations for electric- and gas-fired calciners with special reference to their use in American practice.

[13] G. S. Pope, "Methods of Sampling Delivered Coal," Bulletin 116, U. S. Bureau of Mines.

[14] Such, for example, as that of J. M. Weiss, "Examination of Tars and Tar Products," published by The Barrett Co., New York City.

How the Cement Industry Educates Public on Uses of Its Product

By Thomas J. Harris

THE Portland Cement Association, with its staff of 300 men, most of whom are engineers, is, I believe, the largest association of its kind. Briefly stated, the work of the association is to improve and extend the uses of concrete, which implies educational, promotion and research work. Obviously so small a staff could not make personal visits to more than a very small percentage of concrete users, so the Association has become a somewhat prolific publisher on the subject of "How, Where and Why to Use Concrete." More than 100 treatises or booklets are kept constantly revised for those who are in need of information and, as in all other activities of this organization, no charge or fee is made.

Technical men will readily understand the need for such work as the association does; the user of cement must manufacture his house or well-curb or road right on the ground. It is a chemical and also an engineering process, and though simple, needs close attention and supervision.

The Association is a purely voluntary organization. Any cement manufacturer may belong to it; none need belong. At present eighty-five independent companies are members. Practically all of the cement manufacturers in the United States and Canada do belong and there are foreign members in Cuba, Mexico and South America. These foreign firms become members because of the far-reaching effect of the educational work and the value which cement manufacturers placed upon it as an aid to stabilizing and expanding the market for their product.

The Birth of a Cement Association and Its Raison d'Etre

The inception of the Association is interesting. In 1902 several portland cement manufacturers met at a dinner in New York to discuss a common problem—empty sacks. With the change of the shipping container from the wooden barrel to the returnable cloth sack came the difficulty of getting the sacks back to the mill whose brand they bore. Out on the job, two or more brands of cement might be in use, and the builder seldom took the trouble to bundle separately the empty sacks of different brands. From serving as a clearing house for empty sacks, the meeting grew into a forum for the discussion of other common problems in cement manufacture.

The greatest problem was that of getting the public to use more cement. More mills were being built and operated than could find a market for all of their capacity. Several small associations of cement manufacturers in various parts of the country had been organized, and in 1904 these united to form the Association of American Portland Cement Manufacturers—the first really national organization. One of the great problems of that time was to make the product conform to the many different specifications under which cement was made. Almost every construction engineer prepared his own specifications and the provisions which had to be met were as many and as varied as the names of the engineers. The association appointed a committee on specifications to co-operate with the

American Society for Testing Materials, the American Society of Civil Engineers and the United States Government toward much needed standardization of specifications.

The difficulties about conflicting specifications for portland cement have now been cleared up through this liaison. Standard specifications are agreed upon which are now recognized throughout the United States. By a subsequent amendment to its bylaws, membership in the Portland Cement Association cannot be retained unless the product of the mill conforms fully to the specifications for portland cement as adopted. Thus membership in the Association has become a badge of quality.

Growth and Enlargement of Scope

In 1905 an office with a permanent secretary was opened in Philadelphia, and the organization grew slowly from 1905 to 1916. The beginning of the use of concrete for pavements about 1910 created a great opportunity for service. It was realized that the use of portland cement would increase only with popular understanding of its possibilities. Intelligent and purely commercial self-interest pointed to a policy of public education regarding the proper use of concrete as the surest means of extending the market for cement. There was much that was known about the fundamentals of good concrete, but there was still more unknown. Consequently the Association set to work to tell the public what was known about good concrete, to find out about those things which were unknown, and to tell the public of other facts as they became established.

In 1916 the name of the organization was changed to Portland Cement Association. The general offices were moved from Philadelphia to Chicago, to obtain the advantage of a central location for a truly national organization, and district offices were established in twelve cities, each in charge of an engineer skilled in concrete construction. Each of these district offices had a staff of field engineers who traveled in assigned territories calling on engineers, architects, contractors or any one who might be interested in concrete construction of any kind. This form of field organization is in use today. These field engineers give direct assistance in design and construction problems involving concrete, and the field staff is supplemented by a staff of engineers in the general office at Chicago, prepared to render consulting service on matters which could not be handled directly by the men in the field or by the district offices. Since 1916 the number of district offices has grown to twenty-four, one of which is located in Vancouver, B. C.

The main office at Chicago, as well as the various district offices, is divided into groups, each in charge of a special field of educational promotion. Agriculture, building construction in its broadest sense, sanitation, highway engineering are all reduced to terms of concrete.

The Structural Materials Laboratory

Probably the most important part of the whole educational scheme is the Structural Materials Research Laboratory operated jointly and in co-operation with the Lewis Institute of Chicago. Here a corps of technically trained men are engaged in research work in the various uses of cement and concrete. Considerably more than 100,000 chemical and physical tests have been made in this laboratory since 1916, and the sole purpose of this work is to determine how best to use concrete as well as how not to use it.

In spite of the fact that the Association is now 20 years old and during all that time has been absorbing knowledge on the use of concrete, within the last seven or eight years more has been learned about how to use it than was known in all the years before. Until comparatively recent times nothing was known of the effect which clay and other impurities in concrete might have upon the finished structure. Studies were made in the association laboratory on the size and grading of aggregates, the use of different types of aggregates, the effect of various impurities in the aggregate, the incorporation of various powdered admixtures in portland cement such as coloring matter and hydrated lime. There was also much experimentation on the effect of impure mixing water containing impurities due to industrial waste, etc. These studies were necessary in order that cement should not be blamed for trouble really caused by poor workmanship or impurities in the aggregate or water. This research work has in itself sometimes become promotional in character, as will be noticed in the following incident:

The Imperial Valley of California is now building a concrete road. At the quarry where aggregates were being obtained for the concrete used in this pavement, methods employed in screening and crushing stone for the concrete mixture caused a waste of 35 per cent of the materials taken from the quarry. One of the field engineers who was watching the progress of this work suggested a change in the methods of screening materials based on laboratory tests. This step, he believed would considerably reduce the waste of materials. His suggestion was adopted with the result that the waste was cut down to 15 per cent. On this particular job it cut the cost of stone from $1 a ton to 42 cents a ton and saved $30,000 on the job. This made it possible for the community to build an extra mile of concrete road, furnishing an outlet for more cement.

Co-operative Work Undertaken by the Association

Among the various classes of educational work carried on are lectures before agricultural colleges, farmers' institutes, engineering colleges and universities, co-operation with county agents, architects, engineers, contractors, building commissioners, revision of building codes, establishment of simple courses in the use of concrete in vocational schools.

Portland Cement Association engineers act in an advisory, consulting or inspecting capacity on many pieces of field construction. Practical demonstrations are given on a motor truck with complete concreting equipment traveling throughout various parts of the country.

Many men have been helped to enter the contracting field, specializing in concrete construction. Through educational work there has been promoted a higher standard for buildings in many cities, and this work is being continued everywhere aid is asked. The result of this should ultimately be expressed in economies of construction, more fire-resistant construction and consequent reduction of national fire losses.

Several million educational-informational booklets were distributed last year. These discussed the advantages of the use of cement in the form of concrete construction in many fields. "Concrete on the Dairy

Farm," "Concrete on the Hog Farm," "Concrete Around the Home" are typical titles of these booklets. Booklets or series of booklets devoted strictly to concrete construction in specialized structural fields are kept available. These booklets are revised by the incorporation of the latest information disclosed by study, research or experience and kept up to date.

Motion Pictures of the Industry

The Association uses motion picture films extensively. There is a film showing the process of manufacture of portland cement. It is designed to develop the idea that a sack of cement represents the combined cost of many operations, one of which, for example, is the use of 50 lb. of coal.

The advantages of paved barnyards are displayed through the medium of animated cartoon films circulated in rural communities. Many reports have been received showing that after a local cement dealer had displayed an animated cartoon film in his community he sold within a week or ten days cement for several concrete feeding floors. The Portland Cement Association has no connection with cement dealers except to aid them in developing the cement market by placing at their disposal motion picture films or other educational matter which they may wish to use.

Several Vital Policies

The most important of the policies that have guided the Association from its start was that of excluding rigidly from its activities any matters relating to the sale or distribution of portland cement. Association employees were told that their mission was to create an increased market for cement by helping the public to make good concrete economically, and to give assistance in the planning of concrete improvements so that such structures would best fulfill their intended purpose.

Chicago, Ill.

Elimination of Borates from American Potash*

The Story of the Steps Taken by Producers to Eliminate this Objectionable Impurity from Domestic Fertilizer as Told by the Bureau of Soils

By William H. Ross and William Hazen

THE principal borax or sodium borate deposits in the United States occur at Searles, Borax and Hachinhama Lakes, Calif., and at Rhodes Marsh, Nevada. These lakes are all of the playa type and contain a concentrated brine in association with crystal salts. Crystals of borax ($Na_2B_4O_7.10H_2O$) are found associated with the other salts at each of these lakes, but owing to its relatively low concentration in the original lake water the greater part of the borax still remains dissolved in the brine of the lakes.

Borax may also be obtained commercially from other borate minerals, the most important of which are colemanite, ulexite and howlite.

Colemanite is a hydrated calcium borate, having the composition $Ca_2B_6O_{11}.5H_2O$. It crystallizes in clear glassy monoclinic crystals which are very easily distinguished from the other borates in that they decrepitate on heating and fall to a powder. Colemanite is now the most important source of boric acid and the borates of commerce. The powdered mineral is somewhat soluble in water and is readily soluble in weak acids.

Ulexite is also a hydrated mineral, the composition of which is represented by the formula $NaCaB_5O_9.8H_2O$. It occurs in aggregates of soft acicular crystals, popularly called "cotton balls." It may be fused in a gas flame to which it gives a yellow color. It is readily soluble in acids and is decomposed by hot water.

Howlite is a borosilicate of calcium, $H_5Ca_2B_5SiO_{14}$. It occurs either as friable masses of monoclinic crystals, or as hard porcelain masses. It fuses in a flame, giving it a green color. Howlite is soluble in acids, but much less soluble in water than either colemanite or ulexite.

These minerals are more widely spread than the borax deposits, and are found in San Bernardino, Inyo, Lake and Los Angeles Counties, Calif.; in Clark, Churchill, and Esmeraldo Counties, Nevada; and in Curry, Harney, and Lake Counties, Oregon. They are found associated with borax at Borax Lake, Rhodes Marsh and other places, but sodium borate and tetraborate (borax) are the only borates known to occur at Searles Lake. The deposit at Searles Lake also differs from any of the other deposits mentioned in that the brine is used as a commercial source of potash, as well as of borax. The brine of this lake is a saturated mother liquor, which remained after the crystal salts were formed by the natural concentration of the water from the ancient lake that occupied this basin. The brine is therefore richer than the crystals in such soluble materials as potassium chloride and borax, which occurred in relatively low concentration in the water of the original lake. Analysis of samples of brine taken from various parts of the lake and at different depths show a close uniformity in composition. The composition of an average sample is given in Table I.

TABLE I—CHEMICAL COMPOSITION OF SALTS DISSOLVED IN THE BRINE OF SEARLES LAKE

Total Anhydrous Salts in Brine is 32.85 Per Cent

Constituents	Per Cent of Anhydrous Salts
Sodium, Na	33.57
Potassium, K	6.06
Lithium, Li	0.01
Barium, Ba	none
Magnesium, Mg	trace
Calcium, Ca	none
Alumina, Al_2O_3	0.012
Iron Oxide, Fe_2O_3	0.003
Copper, Cu	none
Manganese, Mn	none
Silica, SiO_2	0.023
Chlorine, Cl	37.02
Bromine, Br	0.094
Iodine, I	0.004
Sulphate, SO_4	12.96
Carbonate, CO_3	6.70
Phosphate, PO_4	0.30
Arsenic trioxide, As_2O_3	0.083
Tetraborate, B_4O_7	3.00
Total	99.839

*Published by permission of the Secretary of Agriculture.

The relation between the potassium chloride and borax in the brine is shown in Table II. For comparison there are also given the mean of numerous results obtained for these salts by the Geological Survey[1] in the analysis of samples taken from different parts of the lake.

TABLE II—POTASSIUM CHLORIDE AND BORAX IN THE BRINE OF SEARLES LAKE

Salt	Found by Bureau of Soils Per Cent	Found by Geological Survey Per Cent
Potassium chloride, KCl	3.82	4.02
Borax, $Na_2B_4O_7.10H_2O$	2.40	2.07
Anhydrous borax, $Na_2B_4O_7$	1.27	1.08

Table II shows that the maximum quantity of borax that can occur in the potassium chloride prepared from the brine of Searles Lake is in the neighborhood of 25 per cent if the greater part of the potash is recovered with the borax.

Borate Content of Potash from Searles Lake

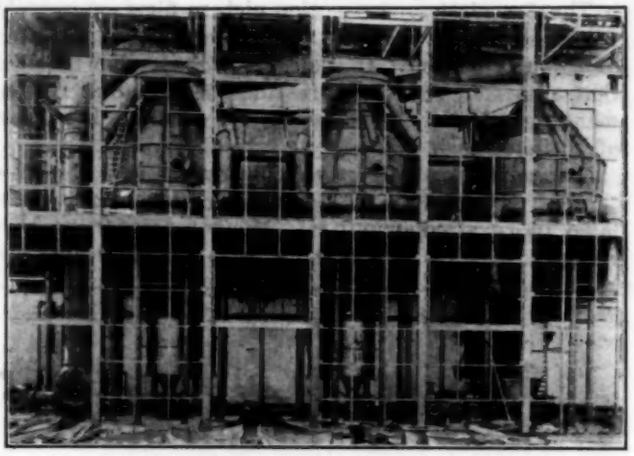
The original process used at Searles Lake for the recovery of potash consisted simply of evaporation and crystallization. The brine was first evaporated to less than half its volume and the solids which separated out from the hot solution, consisting largely of sodium chloride, sodium sulphate, and sodium carbonate were washed back into the lake by a stream of water. The remaining liquor was then run into crystallizing vats and allowed to cool to separate out the potash. The mother liquor from this crystallization was returned to the evaporators to be mixed with fresh brine. The range in the composition of the first crude potash salts produced at Searles Lake is given by the U. S. Geological Survey[2] as follows:

Potassium chloride	60 to 70 per cent
Sodium chloride	5 to 10 per cent
Sodium sulphate	0.5 to 1.5 per cent
Sodium carbonate	1 to 3 per cent
Anhydrous borax	4 to 14 per cent

The first commercial shipments of potash from Searles Lake were made in 1916. During this year a total of 40 shipments were made which were increased to 295 in 1917 and to 376 in 1918. The borax in these shipments showed a wide variation, ranging from less than 1 per cent to a maximum of about 20 per cent.

Crop Injury Due to Presence of Borax in Fertilizer

During the summer of 1919, the attention of the Department of Agriculture was directed to injury to crops by the use of fertilizers. The injury was widespread and serious, especially to the tobacco and cotton crops of the eastern districts of North and South Carolina and to the potato crop of Maine. Several investigators were sent to the regions most affected to study the cause of the injury.[3] Practically all the evidence collected which was later confirmed by field experiments,[4] pointed to the use of fertilizers of potash salts containing borates as the primary cause of the damage to crops. It was observed that the borate content of such mixed fertilizers was roughly proportional to the potash present and that the higher the borate content the greater the injury to crops. The source of the potash salts used in these fertilizers was traced to the salt deposit at Searles Lake.



EVAPORATORS AT TRONA CORPORATION PLANT AT SEARLES LAKE

Analyses of numerous fertilizers reputed to have caused injury to crops showed a borate content varying from 0.75 to 2.0 per cent in terms of anhydrous borax. Considerable difficulty was at first experienced in determining borates in mixed fertilizers by the usual methods of analysis, owing to the interfering action of the soluble organic matter of the fertilizer. However, a modification of the Thompson method was soon developed by the Department[5] which eliminated this difficulty while J. M. Bartlett[6] of the Maine Experiment Station made a satisfactory modification of the Gladding distillation method. The former method gives water-soluble borates in fertilizers and the latter acid-soluble borates. The agreement in the analyses of numerous fertilizers by both methods shows that these fertilizers at least contained only water-soluble borates. This is to be expected inasmuch as the potash salts used in fertilizers are mainly water-soluble and even if there had been added some of the "insoluble" mineral borates, the latter would be rendered soluble by the acid reaction of the mixed fertilizer.

Order Issued by the Department of Agriculture Limiting Borax Content of Fertilizers

As soon as injury to crops by borate-bearing fertilizers was established, the Secretary of Agriculture issued an order under authority of the Control Act of Aug. 10, 1917, which placed such restrictions on the use of fertilizers and fertilizer materials containing borates as would guarantee the use of an application amounting to the equivalent of not more than 2 pounds of anhydrous borax per acre.

[1] Hoyt S. Gale. Potash in 1916. Geological Survey, "Mineral Resources" 1916, Part II, p. 91 (1917).

[2] Hoyt S. Gale. loc. cit. p. 93 (1917).

[3] Crop Injury by Borax in Fertilizers. Oswald Schreiner, B. E. Brown and J. J. Skinner. U. S. Dept. Agr., Circ. 84 (1920).

[4] Borax in Fertilizers. S. D. Conner and E. N. Fergus. Ind. Agr. Exp. Sta. Bull. 259 (1920).

Effect Upon the Growth of Potatoes, Corn and Beans Resulting from the Addition of Borax to the Fertilizer Used. J. R. Neller. *Soil Science* 12, No. 2, 79 (1921).

The influence of Fertilizers Containing Borax on the Yield of Potatoes and Corn, Season 1920. A. W. Blair and B. E. Brown. *Soil Science* 11, 369 (1921).

The Effect of Borax on the Growth and Yield of Crops: Influence of Quantity, Method of Application and Seasonal Conditions. J. J. Skinner, B. E. Brown and F. R. Reid. U. S. Dept. Agr., Bull. (In press, 1922).

Effect of Borax in Fertilizers on Growth and Yield of Potatoes. B. E. Brown. U. S. Dept. Agr., Bull. 998 (1922).

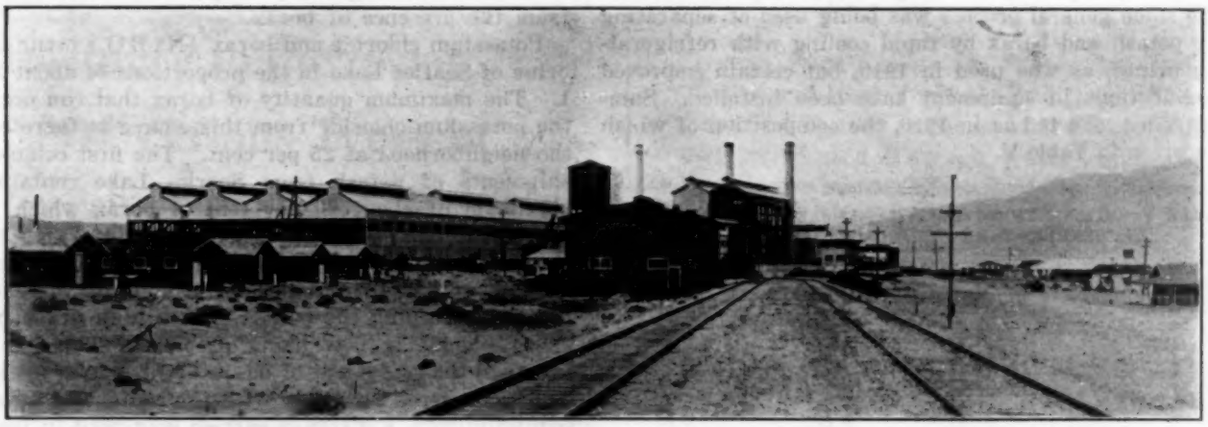
Influence of Fertilizers Containing Borax on the Growth and Fruiting of Cotton. J. J. Skinner and F. E. Allison. *J. Agr. Research*, August (1922).

[5] Methods for the Determination of Borax in Fertilizers and Fertilizer Materials. W. H. Ross and R. B. Deemer. Am. Fertilizer 52, No. 6, 62 (1920); *J. Ass. Official Agr. Chemists*, 5, No. 1, 327 (1921).

Qualitative Method for the Detection of Borax in Mixed Fertilizers. W. B. Pope and W. H. Ross. *Am. Fertilizer* 52, No. 6, 65 (1920).

Report on the Determination of Borax in Fertilizers and Fertilizer Materials. Wm. H. Ross. *J. Ass. Official Agr. Chem.*, 5, No. 1, 80 (1921).

[6] The Distillation Method for the Estimation of Borax in Mixed Fertilizers. J. M. Bartlett. *J. Ass. Official Agr. Chem.*, 5, No. 1, 88, (1921).



GENERAL VIEW OF POTASH PLANT, AMERICAN TRONA CORPORATION

The regulation as applied to mixed fertilizers specified that "hereafter no licensee handling or dealing in fertilizers or fertilizer ingredients shall sell for application to the soil any mixed fertilizer which contains more than 0.1 of 1 per cent of borates expressed as anhydrous borax unless the container thereof be marked, tagged, branded, or labeled so as to show plainly and conspicuously as part of the analysis the percentage of borax present."

The order as applied to potash salts forbade the sale direct to farmers as straight goods, or to any broker or other person for use by farmers as straight goods, potash salts containing borates equivalent to more than 0.5 of 1 per cent of anhydrous borax.

In compliance with this regulation, immediate steps were taken at once by potash producers and fertilizer manufacturers to insure the elimination of borates from all the raw materials entering into the manufacture of fertilizers. Their efforts in this direction have met with such success that since 1919 no mixed fertilizer is known to have been placed on the market with a borate content in excess of the limit specified in the regulation.

Diminished Borax Content of Searles Lake Potash Under Revised Process

On Sept. 5, 1919, an inspection was made of the plant of the American Trona Corp. at Searles Lake, by Dr. J. W. Turrentine of this Bureau. The investigation that was made at that time showed that marked progress had already been made in the refinement of the potash salts. It was found that when the original process was modified so as to bring about a rapid, rather than a normal cooling of the mother liquor from the precipitated sodium salts, the potassium chloride crystallized out as before, but the borax remained in solution. The sludge of crystals thus formed was filtered off and washed in the centrifugals with water for the removal of the retained mother liquor which contained the borax.

Table III gives the composition of samples of the original product and also of material collected at different steps in the process as operated at the time of the inspection in 1919.

At the time the samples listed in Table III were analyzed, an examination was also made of a large number of fertilizer materials from other mineral deposits. A summary of the results obtained is given in Table IV.

The results given in Tables III and IV show that it is commercially feasible to produce a potash product from Searles Lake or any other mineral deposit in this country having a borate content well within the limits set by this Department for that occurring in straight goods to be applied directly to the soil and that the product compares favorably as regards its borate content with the ordinary sodium nitrate imported from Chile.

TABLE III—VARIATION OF BORAX CONTENT OF POTASH SALTS PRODUCED AT SEARLES LAKE BY OLD AND BY THE MODIFIED PROCESSES

No. of Sample	Potash K_2O Per Cent	Anhydrous Borax $Na_2B_4O_7$ Per Cent	Anhydrous Borax Per Unit (20 Lb) of K_2O Pounds
1	31.62	18.14	11.48
2	46.91	2.43	1.03
3	52.57	0.80	0.30
4	52.03	2.61	1.00
5	40.93	0.86	0.42
6	56.26	1.16	0.41
7	54.90	0.28	0.10
8	55.29	0.41	0.14
9	53.23	0.59	0.22
10	50.56	0.20	0.08
11	43.42	0.15	0.07

1. Low-grade potassium chloride prepared by the original process.
2. Medium-grade vat salts prepared by the original process.
3. Potash salts as delivered by filter presses, and before drying and washing in centrifugal driers.
4. Main filter salts unwashed. These are salts as delivered by filter presses without washing in centrifugals.
5. Same as sample 4 but from another section of the pile.
6. Same as sample 4 but from a third section of the pile.
7. Potash shipping salts taken directly from centrifugal driers. The salts represented by this sample were washed on the driers with a small amount of water to remove the mother liquor containing the borax.
8. No. 1 grade filter salts washed with so-called sump solution. From a lot containing 392 tons.
9. No. 1 washed filter salts from another pile of the same grade as that represented by sample 8.
10. No. 2 grade centrifuged filter salts washed with sump solution. From a lot containing 800 tons.
11. No. 2 grade potassium chloride washed with water and which with sample 10 represents the degree to which it is practical to eliminate borax by the modified process.

TABLE IV—BORAX IN MISCELLANEOUS FERTILIZER MATERIALS

Material	Anhydrous Borax Per Cent
Potash salts from Nebraska lakes	0.07 to 0.15
Potassium sulphate from alunite	0.00
German kainite	0.00
German manure salts	0.00
Alsatian manure salts	0.00
Refined potassium chloride from Salduro Marsh	0.00
Refined potassium chloride from Deep Springs Valley, Calif.	0.00
Sodium nitrate from Chile	0.05 to 0.83
High potash nitrate from Chile	0.15 to 3.95

At the request of the American Trona Corporation, a second inspection was made of their plant at Searles Lake, Cal., on April 30, 1922, by Dr. J. W. Turrentine of this Bureau. About 5,800 tons of potash salts were found in storage in the warehouses of the company. Some of this, about 3,000 tons, had been manufactured in the fall of 1920, and the remainder approximately in the spring of 1921. About 300 tons were produced

since the reopening of the plant, 10 days previously. The same general process was being used of separating the potash and borax by rapid cooling with refrigerating brines, as was used in 1919, but certain improved modifications in equipment have been installed. Samples were collected as in 1919, the composition of which are given in Table V.

TABLE V—COMPOSITION OF POTASH SALTS PRODUCED AT SEARLES LAKE DURING 1920 TO 1922

No. of Sample	Potash K_2O Per Cent	Anhydrous Borax $Na_2B_4O_7$ Per Cent	Anhydrous Borax Per Unit (20 Lb.) of K_2O Pounds
1	60.75	0.50	0.16
2	58.72	0.24	0.08
3	57.94	0.39	0.13
4	58.63	0.30	0.10
5	57.64	0.46	0.16
6	61.15	0.36	0.11
7	61.50	0.25	0.08
8	61.80	0.25	0.08
9	59.55	0.27	0.09

1. Potassium chloride from a vertical 5-ft. section of 3,000 tons potash salts manufactured in the fall of 1920.
2. Potassium chloride from loading floor. A part of material manufactured in spring of 1921.
3. Sample of potassium chloride through vertical 5-ft. section near south end of 3,000-ton pile, manufactured during the spring of 1921.
4. Same as sample 3 taken from entire working face 15x50 ft. cross-section of the south end of pile.
5. Same as sample 3 taken from 5-ft. vertical section, middle of pile.
6. Sample from centrifugals as delivered into box for transportation to storage.
7. Sample from box already filled just before being transferred to warehouse.
8. Sample of 300 tons of new potash produced since reopening of plant.
9. Sample of product being delivered by centrifugals, April 30, 1922.

The results in Table V confirm the conclusions arrived at from the data given in Table III, that it is commercially feasible to produce a high grade potash salt from the brine of Searles Lake, having a borate content well within the limits specified by this Department.

This Bureau has followed closely the course of American potash production, not only with a view to assist in establishing commercial sources of potash but also in maintaining a quality of material that would be suitable for use as fertilizer without fear of injury to crops. Borax has been the only substance of a deleterious nature discovered in American potash and the quality of the materials produced during the period from 1919 to 1922 show that the producers have met the requirements of the Department and that under the present method of producing potash at Searles Lake there exists no longer any danger of deleterious effects from the presence of borax.

Potassium chloride and borax ($Na_2B_4O_7$) occur in the brine of Searles Lake in the proportions of about 3.3 to 1. The maximum quantity of borax that can occur in the potassium chloride from this source is therefore in the neighborhood of 25 per cent. The first commercial shipments of potash from Searles Lake contained a maximum of about 20 per cent of borax which when used in fertilizers resulted in serious injury to crops. By modifying the original process so as to bring about a rapid rather than a normal cooling of the mother liquors containing the potash salts a high grade potassium chloride is now being prepared. This contains less than the equivalent of 0.5 per cent anhydrous borax which compares favorably with the content of borax in sodium nitrate, a nitrogen carrier long used in fertilizing the crops of this country. Borax has been the only deleterious substance found in American potash and the quality of the materials produced during 1919 to 1922 shows that the producers have met the requirements of the U. S. Department of Agriculture and that there no longer exists the former danger to crops from the presence of borax in fertilizers.

Bureau of Soils,
Department of Agriculture,
Washington, D. C.

Pure Iron-Carbon-Manganese Alloys

As a continuation of the Bureau of Standards' previous work on the preparation and properties of pure iron and iron-carbon alloys, there has just been completed a series of alloys of electrolytic iron, carbon and manganese, so chosen as to show the effect on the mechanical properties of pure iron of additions of carbon up to 1.2 per cent, of manganese up to 1.5 per cent, and of carbon and manganese together in varying relative proportions up to the same limits. All these alloys were prepared *in vacuo* in order to eliminate as far as possible any effects from gases and in order to obtain sound material without the use of any deoxidizing additions. The ingots of this series were rolled to flat bars, tensile test specimens cut from them and tested in the fully annealed state. The data from these will soon be available as a Bureau publication. This same investigation is being extended to cover simple heat treatments of selected vacuum fuse iron-carbon-manganese alloys.

SEARLES LAKE, CAL.

Resistance to Corrosion Of Various Types of Chromium Steels

Several Pure Chromium Steels, in Cast, Forged and Heat-Treated Conditions, Were Observed During Immersion in Dilute HCl and in Aërated Distilled Water—Relative Resistance to Attack Is Entirely Different in the Two Series

By Henry S. Rawdon and Alexander I. Krynitsky
Physicist and Associate Physicist (Metallography), Bureau of Standards.

LACK of adequate information on this subject in the technical literature together with the numerous requests for information along this line which have been received has led to the publication of the results of these preliminary experiments which were initially undertaken at the request of one of the prominent American steel men. As the work progressed it appeared desirable to test several other materials besides the chromium steels for purposes of comparison (series 21 to 24 of Table I), one of these being a chromium-nickel steel submitted by the manufacturers for the purpose. The tests were carried out in the endeavor to show the relative corrodibility of the various types of steel rather than to study any one material in detail. Hence it was necessary to limit the number of corroding conditions used.

Materials Investigated

The chromium steels investigated (Table I) were prepared by L. Jordan, of the Bureau of Standards, the fusion being made in the high-frequency induction furnace. Only small ingots averaging about 1 lb. (550 grams) each could be made. Armco iron was used as the base material; this contained approximately 0.02 per cent sulphur and 0.015 per cent carbon, with other impurities negligible in amount. To this was added the requisite amount of chromium in the form of ferrochromium containing approximately 60 per cent chromium and 0.25 per cent carbon. For the steels of a relatively high carbon content, the carbon was added in the form of an iron-carbon alloy prepared with electrolytic iron as a base and containing 4.4 per cent carbon. An addition of a small amount of manganese was made to all the alloys and silicon to a portion of the series in order to obtain sound ingots and to render them forgeable.

After the ends had been cropped, the ingots of chromium steel were heated to a temperature slightly less than 1,000 deg. C. and pressed into plates approximately ½ in. in thickness. All of the steels after forging were annealed at 750 deg. C. and most of them received an additional heat-treatment before the corrosion test, as indicated in the subsequent tables in which the results of corrosion tests are summarized. Portions of the cropped ends of the ingots of the cast metal were also tested as being representative of the material in the cast state. The iron and other steels investigated were in the forged condition; samples of the pure iron in the cast condition were also used.

The specimens used for the test were small pieces of a rectangular prismatic shape, the surfaces of which were carefully ground so that their dimensions could be readily measured by means of a micrometer. The effect of surface finish—that is, rough grinding versus polishing—was also noted.

TABLE I—COMPOSITION OF ALLOYS USED IN CORROSION TESTS

Series	Character of Material	Important Elements (Per Cent)					
		Carbon	Chromium	Manganese	Silicon	Sulphur	Nickel
1	Chromium steel	0.45	12.42	0.27	Not determined. Silicon was not used in preparation of the alloys.	Not determined	Not determined, but not present in more than traces.
2	Chromium steel	0.42	11.81	0.27			
3	Chromium steel	1.07	13.18	0.29			
4	Chromium steel	0.28	6.12	0.24			
5	Chromium steel	0.40	7.22	0.23			
6	Chromium steel	0.71	6.55	0.27			
7	Chromium steel	0.057	13.30	.....			
8	Chromium steel	0.040	6.50	.....			
9	Chromium steel	0.38	12.10	0.36	0.36		
13	Chromium steel	0.20	8.60	0.36	0.29		
14	Chromium steel	0.29	13.70	0.76	0.51		
15	Chromium steel	0.29	12.40	0.50	0.61		
17	Chromium steel	0.15	13.00	0.08	0.70		
18	Chromium steel	0.30	5.72	0.06	0.27		
19	Chromium steel	0.40	12.60	0.44	0.27		
20	Chromium steel	0.28	3.90	0.39	0.24		
21	Iron-carbon alloy	0.45	Not detected	Nil	0.003	0.014	
22	Electrolytic iron remelted in vacuo	0.028	Not detected	0.009	0.005	0.016	
23	Invar	0.08	Not detected	0.45	0.18	.....	36.13
24	High-nickel chromium steel	0.32	7.68	0.68	1.03	0.20	20.12 Co 0.10 Cu 0.095 P 0.026

Nature of Test

Two types of tests were used, one for determining the resistance of the materials to corrosive attack by acid, the second one being a simulated "weather" test. Since the purpose of the tests was to demonstrate the relative resistance of a series of alloys of different compositions rather than the behavior of one or two compositions under a series of different conditions, only one acid, dilute hydrochloric, was used. This acid was chosen since its action upon chromium steels is relatively more severe than that of most other acids. The attack is also less complicated in character than is the case with strongly oxidizing acids such as nitric. Results are expressed as the loss in weight in milligrams per square centimeter of surface per day.

The necessity for using either a considerable excess of acid during the acid-immersion test or a rather short period in order to obtain a true measure of the relative solubility of the materials became evident early in the experiments. As the concentration of acid decreased and that of the "corrosion products" increased, the rate of attack, as indicated by the evolution of the gas, was found to diminish noticeably, so that specimens of the same size differing widely in composition were found to lose approximately the same amount if

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the immersion was prolonged enough, although the solutions in which they were immersed showed a strong acid reaction at the completion of the test.[1]

The "weather" test consisted in the exposure of specimens suspended so as to be immersed in distilled water just beneath the surface, the uncovered dish of water being kept near an opened window so that a supply of fresh air at all times was assured. The time required for the appearance of rust for tarnishing of the surface was taken as an approximate measure of the resistance of the material to "weathering" conditions and the specimens could be arranged in order on this basis. A few samples which purposely had not been thoroughly ground free from oxide scale were also tested in this manner to show to what extent the presence of scale affects the rate of corrosion.

In all the tests the samples were suspended by means of silk thread in the water or acid solution used so as to hang freely and not to be in contact with the glass vessel, which might possibly affect somewhat the rate of attack. The identification numbers were not stamped on the material itself, since this might have some effect upon the attack, but were written on a wooden identification tag.

Acid Corrosion

The effect of a hardening treatment upon the rate of attack of typical chromium steels is well shown by series 1 to 6 inclusive in Table II. The apparently anomalous results of series 1 may have resulted from the fact that the quenching temperature used was somewhat low for the composition of this particular specimen. All of the other samples showed a marked decrease in the loss in acid when in the hardened state. The specimens of highest carbon content, for example, 3 and 6, showed the greatest decrease.

TABLE II—RESULTS OF ACID-CORROSION TESTS ON FORGED BARS

Series	Carbon and Chromium, Per Cent	Heat Treatment Received	Character of Surface	Immersion In *N*/2 HCl	Loss in Wt. Per Sq.Cm. Per Day, Mg.	
1	C, 0.45; Cr, 12.42	(a)	Ground	300 c.c., 3 days	17.50	
1	C, 0.45; Cr, 12.42	(a)	Polished	300 c.c., 3 days	17.50	
					av.	17.5
1	C, 0.45; Cr, 12.42	(b)	Ground	300 c.c., 3 days	20.8	
1	C, 0.45; Cr, 12.42	(b)	Polished	300 c.c., 3 days	14.5	
					av.	17.6
2	C, 0.42; Cr, 11.81	(a)	Ground	300 c.c., 3 days	30.5	
2	C, 0.42; Cr, 11.81	(a)	Polished	300 c.c., 3 days	27.2	
					av.	28.8
2	C, 0.42; Cr, 11.81	(c)	Ground	300 c.c., 3 days	22.0	
2	C, 0.42; Cr, 11.81	(c)	Polished	300 c.c., 3 days	17.1	
					av.	19.5
3	C, 1.07; Cr, 13.18	(a)	Ground	300 c.c., 3 days	46.8	
3	C, 1.07; Cr, 13.18	(a)	Polished	300 c.c., 3 days	36.8	
					av.	41.8
3	C, 1.07; Cr, 13.18	(c)	Ground	300 c.c., 3 days	10.4	
3	C, 1.07; Cr, 13.18	(c)	Polished	300 c.c., 3 days	14.2	
					av.	12.3
4	C, 0.28; Cr, 6.12	(a)	Ground	300 c.c., 3 days	24.5	
4	C, 0.28; Cr, 6.12	(a)	Polished	300 c.c., 3 days	20.0	
					av.	22.2
4	C, 0.28; Cr, 6.12	(b)	Ground	300 c.c., 3 days	16.7	
4	C, 0.28; Cr, 6.12	(b)	Polished	300 c.c., 3 days	11.0	
					av.	13.8
5	C, 0.40; Cr, 7.22	(a)	Ground	300 c.c., 3 days	34.8	
5	C, 0.40; Cr, 7.22	(a)	Polished	300 c.c., 3 days	44.7	
					av.	39.7
5	C, 0.40; Cr, 7.22	(c)	Ground	300 c.c., 3 days	14.1	
5	C, 0.40; Cr, 7.22	(c)	Polished	300 c.c., 3 days	12.2	
					av.	13.1
6	C, 0.71; Cr, 6.55	(a)	Ground	300 c.c., 3 days	48.3	
6	C, 0.71; Cr, 6.55	(a)	Polished	300 c.c., 3 days	31.1	
					av.	39.7
6	C, 0.71; Cr, 6.55	(c)	Ground	300 c.c., 3 days	12.3	
6	C, 0.71; Cr, 6.55	(c)	Polished	300 c.c., 3 days	10.8	
					av.	11.5

(a) Annealed at 750 deg. C., and re-annealed after machining at 750 deg. C.
(b) Annealed at 750 deg. C., water-quenched from 813 deg. C., tempered at 180 deg. C.
(c) Annealed at 750 deg. C., water-quenched from 1,000 deg. C., tempered at 180 deg. C.

[1] This feature was discussed at length by D. M. Strickland in CHEM. & MET. ENG., June 21, 1922, vol. 26, p. 1165.

TABLE III—ORDER OF RESISTANCE TO HYDROCHLORIC-ACID CORROSION OF ANNEALED ALLOYS

Order	Series	Character of Steel	Average Loss of Wt. Per c.c. Per Day, In Mg.
1	24	C, 0.32; Cr, 7.7; Ni, 20; Si, 1.0	0.12
2	23	C, 0.08; Ni, 36.13 (Invar)	0.25
3	22	C, 0.028 (electrolytic iron)	0.8
4	20	C, 0.28; Cr, 3.9	3.2
5	8	C, 0.04; Cr, 6.5	3.3
6	21	C, 0.45 (alloy of electrolytic iron and carbon)	4.2
7	13	C, 0.20; Cr, 8.6	5.9
8	18	C, 0.30; Cr, 5.72	7.7
9	7	C, 0.057; Cr, 13.3	8.8
10	1	C, 0.45; Cr, 12.42	17.5
11	4	C, 0.28; Cr, 6.12	22.2
12	17	C, 0.15; Cr, 13.00	27.1
13	2	C, 0.42; Cr, 11.81	28.9
14	5	C, 0.40; Cr, 7.22	39.7
15	6	C, 0.71; Cr, 6.55	39.7
16	3	C, 1.07; Cr, 13.18	41.8
17	15	C, 0.29; Cr, 12.40	62.6
18	19	C, 0.40; Cr, 12.60	73.8
19	14	C, 0.29; Cr, 13.70	77.7
20	9	C, 0.38; Cr, 12.10	84.5

Tests also indicate that, in general, the cast alloys are more resistant to hydrochloric acid attack than are the same materials after being forged.

The relative order of resistance to acid corrosion of the various alloys is best known by comparison of the specimens in the same physical condition. In Table III have been grouped the data which relate to the forged alloys in the annealed state.

"Weathering" Test

The behavior of the materials when exposed under ordinary conditions of atmospheric corrosion was determined by immersing the steels in distilled water, just below the surface, and exposing the uncovered dish to the free air. By observing the change in the appearance of the previously polished surface of the specimens, the period necessary for the appearance of rust spots, the relative extent of the rusted areas after a certain definite period and the change in weight of the specimens, it was possible to arrange the various steels in certain groups with respect to their corrodibility.

In determining the change in weight, the surface was cleaned by rubbing with the finger so as to remove any loosely adherent rust. Most of the specimens showed a very slight decrease in weight, thus indicating that the rust formed under the conditions used was not very firmly adherent.

In Table IV are summarized the conclusions reached concerning the relative resistance of the various steels to "weathering." In most of the chromium steels the corrosive attack was confined to small areas or pits, a fact which suggests that the average chemical composition of the material as determined by analysis is not the only factor which determines the behavior of the steels with respect to corrosion. Since the attack in most cases did not result in a uniform film over the surface, but was restricted to small isolated areas, the changes in weight noted do not appear of as much significance as would be the case otherwise and hence have not been included.

Discussion and Summary

There will be noted in the foregoing tables, particularly in Table IV, in which are summarized the results of the "weather" tests, some results which are very difficult if not impossible for one to explain on the basis of composition alone. The classification which has been given should be regarded as a very loose one, indicating only the general behavior which may be expected of the

various alloys. However, there are some very definite conclusions which the results of the investigation appear to warrant.

1. *Acid Corrosion.*—A comparison of the results of Table III with those of Table IV shows that the relative resistance of a steel to the hydrochloric acid test is not necessarily a criterion of its behavior in atmospheric corrosion. Pure iron and the steels of low chromium content were found to be much more resistant to attack by hydrochloric acid than those containing considerable chromium. When corroded by water and air the general order of resistance was reversed. It may be concluded, then, that the addition of chromium to iron and steel increases the rate of attack by hydrochloric acid and perhaps by others, although this statement may be modified somewhat according to the condition of the steel with respect to the heat-treatment it has received. Specimens which had been hardened by suitable heat-treatment were found to be considerably more resistant to acid attack than samples of the same composition in the annealed state. The addition of nickel is much more effective in reducing the intensity of the attack by hydrochloric acid than is chromium. The steels containing a considerable amount of nickel were found to be the most resistant to acid of all those which were used.

Specimens having a polished surface were found, almost invariably, to show a smaller loss in acid than those which were roughly ground. This difference may be only apparent, however. Although the measured surface of the two specimens may appear to be exactly the same, the one with a "ground" finish has a slightly greater area exposed on account of the minute grooves and ridges which make up the surface than has the polished specimen.

TABLE IV—RELATIVE RESISTANCE OF THE STEELS TO CORROSION IN DISTILLED WATER

Approximate Period Order Before Rust Was Noted		Approximate Area Which Had Lost Luster or Was Rusted After 19 Days	Series of Steels
1	150 days (no rust)	.....	17, 17 (*a*)
2	63 days	.....	9
3	22 days	.....	24
4	13 days	Few very small specks	2 (*H*)
5	7 days	Larger specks, approximating $\frac{1}{8}$ to $\frac{1}{4}$ of surface area	1 (*H*), 3 (*H*)
6	3 days	Ditto	1 (*A*), 9 (*a*), 13, 14, 15 (*a*), 19 (*a*), 17 (*a*), (*b*)
7	18 hours (trace of rust)	Ditto	7, 7 (*a*), 7 (*b*), 7 (*b*) (*a*), 9 (*b*) (*a*), 13, 14 (*a*), 15, 15 (*a*), 17 (*b*), 19, 19 (*b*), 19 (*b*) (*a*)
8	18 hours (trace of rust)	About $\frac{1}{4}$ surface	8, 8 (*a*), 8 (*b*), 13 (*a*), 13 (*b*)
9	18 hours (small amt. of rust)	Small portion of approximately $\frac{1}{4}$ area retained its luster	2 (*A*), 3 (*A*), 4 (*A*), 4 (*H*), 5 (*H*), 6 (*A*), 6 (*H*), 18, 18 (*a*)
10	18 hours (small amt. of rust)	No luster remained. Surface was etched and has a mottled appearance	5 (*A*), 18 (*b*), 18 (*b*) (*a*), 20, 20 (*a*), 20 (*b*) (*a*), 20 (*b*)
11	18 hours (considerable amount of deposit)	No luster remained on surface	21, 22 22 (*a*)

(*a*) Cast, annealed at 750 deg. C. reheated to 500 deg. C. after machining.
(*b*) Specimens had adhering specks of oxide scale on the surface, otherwise they were the same as others of the series.
(*A*) Annealed at 750 deg. C. after forging, annealed at 750 deg. C. after machining.
(*H*) Heat-treated; annealed 750 deg. C., after forging, water-quenched from 1,000 deg. C. (except 1 and 4, 813 deg. C.), tempered 180 deg. C.
Other specimens (except 21 and 24) were annealed 750 deg. C. after forging at approximately 1,000 deg. C. reheated to 500 deg. C. after machining. Specimens 21 and 24 were cut from a forged bar and annealed at 500 deg. C.

2. *Atmospheric Corrosion.*—For resisting corrosion by water and air a considerable amount of chromium in a steel is necessary. The alloys of this general type were found much more resistant than were those of low chromium content. These latter steels, however, were found much more resistant than the simple carbon steel or "pure" iron. Hardening the chromium steel by heat-treatment was found to have a similar effect in retarding corrosion by water and air as in the acid tests. This was true in particular for the steels of high chromium content. The specimens lower in chromium showed very little difference in resistance to corrosive attack regardless of their condition with respect to heat-treatment. Adhering patches of oxide scale upon the surface were found to have a very noticeable effect in accelerating the rate of attack of the chromium steels.

The alloy containing a high percentage of nickel as well as chromium which was found to be attacked the least by acid also proved very resistant to atmospheric corrosion. It was much better than most of the chromium steels used, although it was far surpassed by certain of the high chromium materials tested.

It was noted in most cases that the corrosion of the chromium steels consisted in an attack at small isolated spots rather than in a general tarnishing and coating of the surface. This, in view of the fact that adhering particles of oxide scale accelerated the corrosive attack of a steel to a very marked degree, suggests that the presence of inclusions or other defects within the material may be responsible in large measure for the character of the surface pattern resulting from the corrosive attack of these steels.

It will be noted that the high-chromium steel which proved to be superior to all the others in its resistance to "weather" corrosion contained a considerable amount of silicon. However, whether this fact is of real significance is a matter of conjecture so far as the present tests indicate. Specimens 14 and 15, which also contained considerable silicon, though less than specimen 17, did not show any unusual corrosion-resisting properties. The difference in carbon and manganese contents in these specimens may be of pronounced significance, however, in this respect.

In the choice of a "non-corrodible" steel, the character of the service will be the criterion which determines which is the proper type to use. For example, it is evident from the preceding results that as a material for which the resistance to severe acid attack, such as hydrochloric, is the principal requirement, a high-chromium steel would be the least suitable of all the materials used in this investigation. In most cases, however, the service which any material will undergo is a combination of various factors. Thus, for example, cutlery steel must withstand both acid and atmospheric corrosion as well as possess certain necessary mechanical properties, "forgeability," hardness, etc. No single type of non-corrodible steel appears to be suitable for each and every purpose which may arise.

Competition of Indian Mica

A feature that renders it almost imperative for the America mica producer to develop more efficient methods is the competition with cheap Indian labor, acccording to Oliver Bowles, mineral technologist of the Bureau of Mines. Labor costs in India are exceedingly low and it is difficult, therefore, for Americans with their higher standards of living and consequently higher wages, to compete successfully with the Indian product. Mining methods in India are very crude and laborious and it is only by taking advantage of superior methods that America can hope to succeed in establishing a flourishing mica industry.

Maturing Flour—I

Summary of Present Knowledge Regarding the Action of Chlorine on Flour—Maturing Effect—Baking-Quality Stabilized as Result of Arresting Enzyme Activity So That the Acidity May Be Maintained at the Optimum Point

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WHILE a large number of methods have been proposed for treating flour in order to improve its color or quality—as is evident from a study of Dr. Morison's résumé of flour-treating methods published recently in *Baking Technology* under the caption "Why Bleached Flour?"—very few of these have been of any particular moment in a practical and operative way and have achieved anything like a commercial success.

So far as practical adoption by millers is concerned, the forerunner of all the methods is what is known as the nitrogen dioxide process. As now conducted, its operation depends on the heat generated by an electric discharge causing some of the oxygen and nitrogen of the air to combine, with the formation of nitric oxide. This substance then takes up oxygen from the air and forms nitrogen dioxide. It is this latter that is the active agent in this process for treating flour.

This method of treating flour with NO_2 is the earliest of the commercial methods used in the United States, and the flour so treated was known as "bleached flour." The method and product produced by such method have been the source of extensive litigation both in this country and in England. Nitrogen dioxide-treated flour was the one which became more or less generally known through government activities, for at that early period it was the sole treated flour on the American market. Published results of experiments both in this country and abroad indicate that flour treated with nitrogen dioxide, while very much whiter than before treatment, is not materially affected in its baking quality.

While the term "bleach" from a dictionary standpoint does mean "to make white," yet with this historical setting, it has come to mean the treatment of a flour whereby such flour is made whiter, but nothing else.

AGING OF FLOUR

Flour when it ages turns whiter and increases in the quantity of acidity. As flour ages, it becomes a better flour, for it produces a larger and better loaf of bread. Freshly milled flours do not produce the best of which they are capable. A great advance was made in the milling art by the introduction of a method for treating flour in the mill, whereby such freshly milled flour at once took on the properties of a properly aged flour, so that the flour could then go to the consumer in condition to render at once its highest baking value.

The aging of flour is not commercially feasible. The cost is against it, for one thing. Another objection, from a commercial standpoint, is the impossibility of following the condition of the aging flour, especially if one wishes to catch it at its peak, for stored flour is constantly varying in its baking capacity, finally reaching an optimum and then beginning to decline. Hence any method which the miller can employ, assuming for the moment that it is unobjectionable from a health standpoint, which will instantly convert a flour to its optimum baking value and then stabilize it, is of great moment to the public.

MATURING OF FLOUR BY CHLORINE TREATMENT

This state of affairs is brought about in flour by treating it with chlorine, and the general result is known as "maturing"—*i.e.*, the general effect of "maturing" flour is that which nature produces in aging flour—a whitening effect together with greatly improved baking qualities. It is quite evident that there is a distinction between "bleached" and "matured" flour.

NATURE OF COLORING MATTER IN FLOUR

Whatever the method used to treat flour, if the resultant product is whiter, then it is certain that the yellow coloring matter of the flour has been discharged to a greater or less extent. Not much is known concerning this yellow coloring matter of flour, but in 1912 Dr. G. W. Monier-Williams established its identity with carotin, the yellow coloring matter found in carrots and also in the green portions of plants.[1] While the amount of carotin contained in flour will vary considerably, in no case is it very large, Monier-Williams having found 1.3, 1.4 and 2.0 parts per million in samples of patent flour.

Willstätter and Mieg[2] have shown that carotin is a hydrocarbon, $C_{40}H_{56}$. It forms red crystals of a coppery luster having a melting point of 167.5 to 168 deg. C. With the halogens it forms addition compounds of the type $C_{40}H_{56}I_2$. The relative toxicity of carotin and dichlorcarotin, $C_{40}H_{56}Cl_2$, has been studied by Wells and Hedenburg,[3] who reached the following conclusion: "Evidently carotin possesses no considerable toxicity if any, and chlorination does not make it demonstrably toxic. The quantities of carotin used in these experiments are enormous in comparison to the amounts that could be obtained from any food, even carrots. The larger doses used, 0.2 g., are as much as is contained in 200 kg. of flour. . . ."

OXIDATION OF CAROTIN CAUSES WHITENING OF FLOUR

Willstätter and Mieg say that carotin absorbs oxygen and is thereby completely decolorized. The oxidation goes on rapidly even in the dark and in the absence of moisture. In one set of experiments Monier-Williams exposed 0.1 to 0.2 g. samples of carotin to the air for two months in both the city of London and in Widnes.

[1] Report to the Local Government Board by Dr. G. W. Monier-Williams, on the nature of the coloring matter of flour and its relation to processes of natural and artificial bleaching.
[2] *Ann.*, vol. 355, p. 1 (1907).
[3] *J. Biol. Chem.*, vol. 27, p. 213 (1916).

These increased in weight about 30 per cent and became lighter in color—i.e., a light orange red. The increase in weight was at first very slow, being scarcely perceptible for six days, but after this it became fairly rapid. In one sample, equilibrium was reached in 75 days with 32.3 per cent "oxygen absorbed." This corresponds fairly well with the 34.3 per cent oxygen absorption obtained by Willstätter and Mieg, in treating carotin with pure oxygen.

The Role Played By Nitrites in Whitening Flour

An interesting observation of Monier-Williams on these exposed samples is that the smallest trace of nitrite could not be detected in any of these carotin samples by the Griess-Ilosvay test, even after the carotin had been submitted to long exposure to the atmosphere, nor could any nitrogen be found by the Kjeldahl method on a 0.2-g. sample using salicylic acid and sodium thiosulphate. He remarks that "it is only reasonable to assume that the natural aging of flour is a similar process." It is reasonable to assume that Monier-Williams means that the whitening of flour through aging is a phenomenon due to the oxidation of the carotin.

He showed that carotin combines or reacts readily with NO_2, and also states that flour exposed to the air takes up nitrite-reacting material or such nitrite-reacting material is produced within the flour itself. Would not the inference be a fair one from Monier-Williams' and Willstätter and Mieg's results, that in all likelihood nitrite-reacting material plays little or no part in the whitening of flour on aging, but that oxygen plays the major rôle? Be that as it may, Wesener and Teller state with respect to the use of NO_2 that "evidently the artificial aging of flour is identical with the natural aging which has been going on ever since white flour was produced."

Action of Chlorine on Flour

So far as the action of gaseous chlorine on flour is concerned, it would seem that the broad principles of such action may be stated by saying that it acts on the carotin and unsaturated glycerides, forming addition products. We know further, that water and chlorine react, this reaction being carried on until an equilibrium is established between the HCl and HClO formed and the H_2O and Cl. Hypochlorous acid would, of course, be readily reduced with the formation of hydrochloric acid. The equilibrium would then be reestablished with subsequent reduction of the HClO and so on, until the chlorine has been converted into hydrochloric acid. It is the hydrochloric acid which gives the increased acidity to flour which is treated with chlorine, and this increase is capable of control by the degree of treatment.

Baking Quality Stabilized by Maturing

There are also other interesting changes which take place in flour which has been subjected to this action. Among these is one which acts so as to maintain the acidity of the treated flour at a constant point. This constitutes a marked differentiation from untreated flour, the acidity of which keeps constantly increasing. Inasmuch as the intensity of the acidity is probably the most important variable in determining the baking value of any flour, it will be of interest to give an example of results obtained from a fresh flour and the same flour subjected to treatment with chlorine. The sample in question was a spring wheat:

Flour	Time	Ash, Per Cent	Acidity	Volume, c.c.
Fresh	At once	0.40	0.112	2,060
Matured		0.40	0.151	2,340
Fresh	After 116 days	0.40	0.133	2,300
Matured		0.40	0.151	2,350
Fresh	After 259 days	0.40	0.135	2,390
Matured		0.40	0.151	2,350

From these results it can readily be seen that the fresh flour had nearly reached its optimum in baking capacity, whereas the matured flour remained constant. The greatest change in the baking value of the fresh flour developed after four months of storage, but the baking value continued slowly to increase up to the ninth month and had not yet begun to recede.

On the other hand, a sample of fresh flour in storage gave these results: The volume of the loaf was, when the flour was baked at once, equal to 2,050 c.c. After 117 days this volume had increased to 2,440 c.c.; after 308 days the volume had decreased to 2,250 c.c. The difference in the time it takes a natural flour to age to its optimum value is undoubtedly not only influenced by storage conditions, but by the different blends of wheat from which the flour is produced and by the method of tempering, as well as the manner of milling.

In this connection, it is interesting to note a reference to some, as yet unpublished, work of Bailey and Johnson, which is found in the concluding installment of Dr. Morison's article on "Why Bleached Flour?":[1] "Bailey and Johnson (1922) have studied the effect of chlorine bleaching upon the electrolytic resistance and hydrogen-ion concentration on water extracts of flour. They found that bleaching flour with chlorine increases the specific conductivity, hydrogen-ion concentration, and buffer action of flour extracts in direct ratio to the quantity of chlorine used. These differences apparently do not disappear on storing the flour for some months."

Enzyme Activity Arrested

This stabilizing of the baking quality of a matured flour, which baking quality depends so largely on the hydrogen-ion concentration, is undoubtedly due to the action of the chlorine on the enzymes normal to the wheat berry, whereby their activity is arrested. This raises the question as to what the increase in acidity of a stored flour is due. So far as we now know, the acidity of flour is due to phosphoric acid or its acid salts, and to amino acids; the former are doubtless of more importance from the standpoint of acidity. The source of the phosphoric acid or its acid salts is phytin, which undergoes hydrolytic cleavage through the activity of the enzyme phytase. Proteolytic enzymes would hydrolyze the proteins, with the formation of amino acids as a final cleavage product. Proteolytic enzymes do not all have the capacity to hydrolyze proteids to the extent that amino acids are formed. For example, pepsin causes a hydrolysis of proteids with formation of proteoses and peptones, which are only an intermediate step toward the amino acids.

The arresting of the activity of the enzymes in flour by the action of chlorine is not a serious matter. The enzymes that are present are there for the sole purpose of acting when the wheat berry is utilized to produce its kind. Then these enzymes become necessary to split the contents of the berry into suitable food, for

[1] *Baking Technology*, vol. 1, p. 135 (1922).

nourishment of the growing embryo, until the root system has been established and the young wheat plant can obtain proper food from the soil. In discussing some work of Baker and Hulton,[8] who had carried on experiments to determine the value of the enzymatic constituents of flour as they might effect bread making, Humphries has remarked that "these ferments were there to make the kernel of wheat available as food for the young plant," and that "nature in making wheat was more concerned with the reproduction of its kind than in feeding human beings."

Amount of Chlorine Varies With Nature of Flour

It is not possible to give any exact figures on the amount of gaseous chlorine necessary to add to any flour in order to produce that concentration of hydrogen ions so necessary to develop in the flour its highest baking value. It is somewhere in the neighborhood of 150 parts per million, but it may be more and it may be less. In a comparison of the different grades of flour it is necessary to contend with a greater buffer effect in the lower grades than in the higher, so that the lower grades on this account require a larger amount of chlorine to produce the necessary intensity of acidity. This buffering effect is due probably to phosphates, and possibly to the proteids too, as has been pointed out by Jessen-Hansen, Lüers and others. Recent work of Bailey and Peterson[9] lead them to the view that in the extracts from flours the phosphates may be the principal buffers. They say that "electrometric titration curves show the extracts of high-grade flours to be buffered less than the extracts of lower grades. It consequently requires less acid to bring the hydrogen-ion concentration of a high grade or patent flour dough to the optimum for bread production than is required for a low-grade flour. Possibly some of the difficulties experienced in making satisfactory bread from the lower grade or clear flours may be due to failure to obtain the optimum hydrogen-ion concentration of the dough." They also say: "In view of the decided differences in the buffer action of high-grade or patent, and low-grade or clear flours, it is possible that some of the difficulties experienced in producing satisfactory yeast-leavened bread from the lower grades may be due to failure to obtain the proper hydrogen-ion concentration of the dough. Further experimentation with these lower grades of wheat flour, containing more than 0.60 per cent of ash, should be conducted to ascertain the possibilities in this direction. Since conditions generally are unfavorable to the production of choice bread from clear flour, it is probable that a more careful adjustment, within narrower limits, is necessary than in case of doughs made from patent flour."

Importance of Controlling Hydrogen-Ion Concentration

Within the limits of this paper it is not practical to discuss the splendid experimental work which is being done on flours not only in this country but also abroad. The general trend of all these investigations is toward the utilization of physicochemical methods in studying flour *per se*, as well as gluten. Out of all this work has come some splendid results, and it is to be hoped that the time is not far distant when that most important scientific question of what constitutes the strength of flour will be solved. Whether the answer will be found revolving around the colloidal properties of the various flour constituents remains to be seen. Already considerable is known about the effects of varying hydrogen-ion concentration and of salts on the imbibition properties of gluten. This affects markedly the physical properties of the dough and the elasticity of the gluten. In order to get best baking results the gluten must have the proper elasticity and the dough the proper viscosity. The intensity of the acidity of the flour or dough is the most important variable in bread making. We know that when we control, in a proper fashion, the hydrogen-ion concentration through the treating of flour with chlorine, we are on substantial scientific grounds. In this fashion we are able to influence the viscosity of the dough until it becomes practically a minimum, at which point the gluten seems to have the proper degree of elasticity. As Bailey and Peterson have said:[7] "Through the proper hydrogen-ion concentration the elasticity of the gluten and the activity of the yeast and of 'rope-producing' bacteria are affected in the right direction."

Henderson, Fenn and Cohn,[8] in their study of the "Influence of Electrolytes Upon the Viscosity of Dough," remark that " . . . it is evident that with variation in hydrogen-ion concentration, viscosity passes through a minimum a little on the acid side of *pH*5. Jessen-Hansen found *pH*5 to be the best hydrogen-ion concentration in bread making, and it is also, as has been observed, the most favorable for the rising of dough." They also state that their studies indicate that so far as CO_2 production during fermentation is concerned, the best results are obtained near the point of minimum viscosity.

It is also probable that it is due to the favorable action of the hydrogen-ion concentration on the activity of the yeast enzymes that we find that the fermentation period of a dough is materially decreased as we approach that point where the intensity of acidity is most favorable for the optimum baking results.

Cohn and Henderson[9] have summed up quite concisely the value of acidity: "In the first place the desirable length of the fermentation is determined by the acidity of the dough. Increase in the acidity increases the activity of the yeast and shortens the fermentation. Consequently the amount of sugar required by the yeast is diminished (unpublished observations of the authors). Besides, the rate of carbon dioxide production of the yeast within the dough, the tenacity and elasticity of the dough and the escape of gas from the dough are dependent upon the acidity. Experience in this and other laboratories has shown that the best acidity for the baking of bread is indicated by the turning of methyl red from orange to red. In sum, the acidity of the dough at the time of baking seems to be the most important variable factor in bread making."

In this connection the following quotation from an article by Henderson[10] is of interest: "It is possible, however, to measure the hydrogen-ion concentrates of bread by the addition of the ordinary solution of methyl red (0.02 per cent in 60 per cent alcohol) to the partly cut surface of the loaf. Three or four drops of the indicator should be placed upon a single spot and five minutes should be allowed to pass. Then, if the color is a full red without an orange nuance, the hydrogen-

[8] *J. Soc. Chem. Ind.*, vol. 27, p. 273 (1908).
[9] *J. Ind. Eng. Chem.*, vol. 13, p. 916 (1921).
[7] *J. Ind. Eng. Chem.*, vol. 13, p. 916 (1921).
[8] *J. Gen. Phys.*, vol. 1, p. 387 (1919).
[9] *Science*, vol. 48, p. 50 (1918).
[10] *Science*, vol. 48, p. 247 (1918).

ion concentration is approximately 10^{-5}N, or more. If an orange tint develops, greater amounts of acid should be added to successive batches of dough until the test with bread just gives the desired color. . . ."

So far as "rope" is concerned, it has been clearly established that the growth of the *bacillus mesentericus* which causes rope is practically inhibited at a *pH* of about 5.

Summary

The chemical phases of the maturing of flour, in particular the action of chlorine, have been described. The main conclusions to be drawn from the foregoing discussion may be summed up as follows:

Any treatment of flour, to condition it for its best baking results, which does not increase the intensity of its acidity does not condition the flour in the same manner as such flour is conditioned in storage. As Jessen-Hansen[11] has so aptly put it: "Of the different artificial means advocated in recent times as being capable of ameliorating flour, none are of value other than those which increase the hydrogen-ion concentration in the dough."

The proper control of the intensity of the acidity of flour, such as may be accomplished through treatment with chlorine, or any other means which accomplishes the same results, affects favorably those factors which are so essential to the satisfactory baking efficiency of a flour.

The optimum intensity of acidity for the best results is such that methyl red should just turn red without any orange nuance when this indicator is applied to the freshly cut surface of the oven product. This change in the color of the indicator is produced when the concentration of the hydrogen ions is about 10^{-5} normal, or, in other words, the *pH* is about 5.

The intensity of acidity is that factor which, under proper control, favorably affects the dough viscosity, by reducing it toward its minimum and, at the same time, produces those changes which increase the elasticity of the gluten. It lessens the period of fermentation by increasing the activity of the yeast. It also acts favorably in the control of "rope."

Flour which has been submitted to the chlorine treatment is stabilized in the sense that its improved baking capacity remains constant for many months. This stabilizing is brought about by arresting the actions of those enzymes to which is due the increase in acidity of an untreated flour when stored.

The acidity of flour is its most important variable. Hence the treating of flour with chlorine and the consequent production of the optimum intensity of acidity is at once a great asset to the miller as it is to those who use his output and that means each and every one of us. This means of controlling this important factor —acidity—is a great advance in the milling art. Now, the flour buyer can obtain a stabilized flour at its enhanced baking capacity. Although not previously discussed, it may not be amiss to say that such chlorine-treated flour is stabilized in yet another sense, and this is of importance too. Such flour is much less readily subject to the usual rancidity, mold and insect infestation.

Part II, dealing with the method for treating flour with chlorine on a commercial scale, will be published in a subsequent issue of "Chemical and Metallurgical Engineering."

[11] *Compt. rendus. trav. lab. Carlsberg*, vol. 10, p. 179 (1911).

Some New Sources for Vegetable Oils

The development of tomato catsup and soup manufacture has resulted in a great production of tomato seed each year that has been going to waste. The oil from these seeds has been found after refining to be a suitable food oil. By pressing, the yield is about 18 per cent of the dry weight of seed, and if a solvent is used the yield is increased to 20 or 22 per cent. In Italy, where the tomato-pulping industry has been developed on a large scale, tomato-seed oil is a commercial product. It is estimated by the Department of Agriculture that the equivalent of 1,500 tons of dry seed is produced annually in the United States.

The sunflower is a possible source of oil, a large quantity of it having been made from sunflower-seed in Russia before the war. The cold-pressed oil is used for culinary and other purposes where a high-grade edible oil is required, while the hot-pressed is employed in making soaps and Russian varnishes. In 1911, more than 500 mills in the Caucasus were engaged in pressing sunflower seed. It is possible that the sunflower may some day be an important oil-producing plant in this country. The crop is now grown to quite an extent in some parts of the country, notably Missouri, for poultry feed.

Considerable quantities of okra seed could be produced every year by letting the plants ripen seed after the harvesting season is over. This seed contains about 18 per cent of an oil that much resembles cotton-seed oil; in fact, okra and cotton belong to the same, botanical family.

Cohune nut oil, which is obtained from the fruit of a variety of palm tree that grows in Central and South America, has been examined by the department. It resembles coconut oil and can replace it for many purposes. The supply of these nuts is almost unlimited and several firms are now attempting to establish the manufacture of the oil on a commercial basis.

Swiss Aluminum Industry

Before and during the war the policy of the Swiss aluminum industry was directed towards supplying German industries with aluminum, according to a recent number of *The Iron and Coal Trades Review*. The depreciation of the mark and the increase in German aluminum production during the war however, induced the German industries to abandon the Swiss metal. While, in 1913, 5,645 metric tons of aluminum and in 1920 even 3,542 tons were exported to Germany, the exports dropped in 1921 to 1,646 tons. This compelled the Swiss aluminum industry to look for new markets, which were found in 1921 in the United States and Japan. Thus in 1921, 3,421 tons of aluminum found their way to the United States, and 894 tons to Japan. Besides this, Switzerland's aluminum industry, which is concentrated in the hands of the Neuhausen concern (capital 42,000,000 fr.) has commenced paying more attention to the aluminum-working industries in Switzerland, and to participate financially in them. At the present time there are in Switzerland a number of mills which roll the metal into bars, plates, tubes and wire, and which exported during 1921, 1,193 tons. Half of this amount went to the United States and one-quarter to British India. Several factories of aluminum vessels and other goods exported close upon 5,000,000 fr. ($1,000,000) worth of goods in 19[illegible]

Book Reviews

MECHANICAL TESTING by *R. G. Batson* and *J. H. Hyde*. Vol. 1: Testing of Materials of Construction. London: Chapman & Hall, Ltd. 413 pp. 1922.

The authors, members of the engineering staff of the National Physical Laboratory, have undertaken to write what can be considered a textbook on mechanical testing. Their excellent work fills a definite and longfelt want for such a book, particularly for one covering Anglo-Saxon technique.

In discussing the standard shape of "load-extension curve," p. 30, would it not be advisable to call attention to the fact that these curves from recording machines are always misleading in their appearance, since the "maximum load" is indicated for a cross-sectional area of the specimen which no longer exists when that load is reached. Irregularities in curves, when the metal passes from the elastic to the plastic state, can not be explained by inertia of the elastic system present in the apparatus; these irregularities are present in irons and plain carbon steels, but not at all in other metals. This link in the curve is still an unsolved problem; it seems that no means are as apt to solve this mystery as Dalby's optical load-extension recorder.

While theoretically the use of dead weights is the best method for calibration of testing machines, the "standardizing boxes" mentioned under paragraph 52 have been found to be quite accurate and constant, both in tension and compression, and they certainly are very much handier than dead weights or calibrating levers.

The title of Chapter XVIII, "hardness and abrasion tests," is confusing, since hardness (commonly interpreted as "resistance to permant deformation") and resistance to abrasion are properties of entirely different nature and should be treated separately. The confusion in the field of hardness testing is already so large that nothing should be done to increase it. Furthermore, the reviewer cannot agree with the authors' two categories of methods for testing hardness. Abrasion and scratch tests are of different nature. In the abrasion or "wear" test (which is not a hardness test) particles of the material are progressively torn away. In the scratch test of Turner, Martens or the "microcharacter" a groove is obtained by successive compression of the metal over adjoining micro-sections of the surface; it therefore is also an indention test. The definition of hardness as "resistance to permanent deformation" is in no way disturbed by measuring hardness by a scratch test. It must be kept in mind that no "indentation" test gives any information on the resistance to abrasion.

In this connection, I believe it incorrect to state (as the authors do in paragraph 188) that the abrasion test has been applied as a scratch test or as a drill test; abrasion resistance can be investigated only by abrasion. Drill tests are again of entirely different nature. We must differentiate between the micro-drill test of Jaggar which—like the diamond or sapphire scratch test—is a test for the comparative hardness of the individual crystals, and the drill test of Bauer, Keep, Kessner or Ludwik, who, by means of a large steel drill, investigated the resistance of metals to drilling in order to determine their "machineability." In the section on small machines for determining Brinell hardness of thin sheets (paragraph 182) the special machine developed for this purpose by Brinell and made by the Alpha Co. should be mentioned, as later machines are patterned after Brinell's. One might mention that the Brinell or other indentation hardness of thin sheets, as far as annealed stock is concerned, is of rather doubtful value; the Erichsen cupping test will be found more convenient, and it yields more direct information on how the material will "work." It is perhaps superfluous to remark that depth indicators (paragraph. 185) should never be used while the metal is exposed to pressure, "during the test," but only after the load has been released. The first instrument of this kind, of the mercury capillary type, was designed by Brinell and is still being made by the Alpha Co. All depth indicators give very confusing results and for this reason the measurement of the diameter of Brinell impressions is preferred by most of the American laboratories.

The "Auto Punch" described in great detail on pp. 286 and 287, recently imitated by several German apparatus manufacturers, does not give results comparable to Brinell numbers, as the resistance of metals to impact penetration is quite different from that to static ball pressure and this factor varies with the alloy. Besides this fundamental point which in itself excludes accurate results, the springs in these instruments cannot remain constant in usage. The "Waldo hardness tester," pp. 288 to 289, might be eliminated, as this instrument, for obvious reasons, is not in use anywhere.

Methods and apparatus for investigating the cutting efficiency of tool steels are not mentioned; these investigations are as difficult to carry out as they are important and it is to be hoped that the authors will discuss them in detail in a future edition of their book, particularly since splendid work in this direction has been carried on at Sheffield for a number of years.

These few points where the reviewer is inclined to disagree with the authors, should not be allowed to overshadow the thousands of accurate facts contained in the book.

In general, Batson and Hyde's book is very well written, clear and concise, and it gives much valuable information on the technique of mechanical testing. It should be on the desk of every metallurgist and engineer of materials. It will also serve admirably as a textbook in college courses on mechanical testing; in fact, the testing of the mechanical properties of metals should form and will ultimately form an important part of the curriculum in metallurgical engineering, as well as in mechanical engineering.

HERMAN A. HOLZ.

Steel Worker's Handbook

"HÜTTE," TASCHENBUCH FÜR EISENHÜTTENLEUTE. Published under the auspices of the *Akademischen Verein Hütte*, Berlin. Second Edition. *Prof. Hanemann*, Editor-in-Chief. June, 1922. Wilhelm Ernst and Son, Berlin, Germany. 963 pages, 511 illustrations. 738 marks.

Hütte has been the constant companion of more than one generation of Continental engineers, and editions of various dates are to be found in the working libraries of many Americans. Covering in a comprehensive manner the entire field of engineering, it could only be supplanted by a collection of handbooks covering civil, mechanical, electrical, metallurgical and mining engineering. In 1910 it was decided to collect together the material applying directly to the engineering of iron and steel works and foundry, and supplement it by auxiliary material sufficient for a self contained separate volume. The present book is the second edition of this separate. It has been thoroughly revised by an imposing array of *Prof., Dr.-Ing., Geh. Reg.-Rat., Direktors*, etc., and over 100 new pages added.

It is principally concerned with the design and construction of iron and steel works and foundries. Little attention is paid to metallurgical practice—for instance, the details of a converter and its accessories occupy 18 pages while 3½ suffice for the "metallurgy and operation." No attempt is made to discuss the properties of the resulting product. But in the field of design and construction it is quite comprehensive, outlining an enormous amount of material on all branches of the industry from coke oven, through the power plant, blast furnace, steel making departments, to the rolling mills, not forgetting such specialties as sheet coating departments, hammer and press work, pipe making, wire drawing and the manufacture of wire products. An excessive amount of space—about 50 pages—is given to roll design and rolling mills are discussed at length and in great detail.

Therefore, while the book would undoubtedly be of great use to an engineer engaged in the design and construction of steel works, it is of only secondary interest to the operator or metallurgical engineer and practically of no use to the purchaser or fabricator, foundry, machine shop, or manufacturer of metallic articles. An attempt has been made to widen the scope of the book by including a pre-

liminary section on Allied Sciences. This contains an outline of metallographic practice, and an especially good description of the binary alloy systems between iron and all the common elements. Another notable chapter is on the thermal characteristics (and methods for such determinations) of metals, slags and refractories. An outline of qualitative and quantitative analysis of steels and furnace and coke oven materials and products is also included.

From a book-lover's viewpoint, the present volume, when compared with the pre-war editions, is a vivid reminder of the economic plight which has descended upon Germany since their failure to grab world dominion. The old volumes are bound in delightfully rich, smooth and flexible leather, and printed on the finest coated paper. The present edition is on paper suspiciously like news print, and the binding is like that which we are given on the latest "best sellers."

E. E. THUM.

Recent Chemical & Metallurgical Patents

British Patents

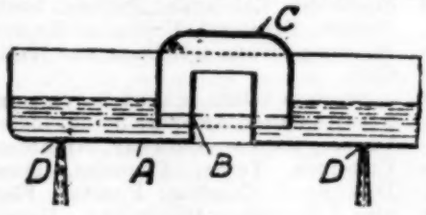
For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

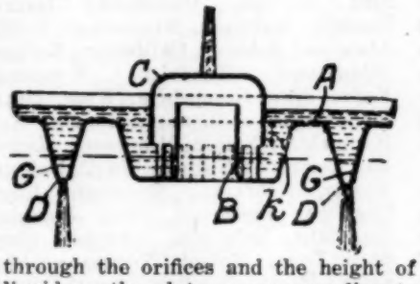
Activated Carbon — Active charcoal is made by impregnating lignite or peat or a coked product thereof with caustic alkali or alkali carbonate, heating to a high temperature and removing the alkali. The activity is increased by subjecting the material to a partial vacuum before impregnation. (Br. Pat. 178,779. W. Carpmael, London. June 21, 1922.)

Anthraquinone — Anthraquinone is prepared by condensing orthobenzoylbenzoic acid with sulphuric acid of 75 to 80 per cent strength. The process may be made continuous by continuous addition of molten ortho-benzoylbenzoic acid and by maintaining the strength of the sulphuric acid either by evaporation such as by blowing in air or by addition of oleum. The anthraquinone separates on cooling from the comparatively weak acid. (Br. Pat. 176,235. F. W. Atack, Manchester. April 26, 1922.)

Oleomargarine Manufacture—In the manufacture of margarine and other edible fats especially from vegetable fats, an oleaginous material having "water-dispersing properties" is added to the usual ingredients, or to margarine after manufacture, so that an emulsion is formed having the aqueous liquid as the internal phase in a state of very fine subdivision. The water-dispersing medium may be prepared by heating soya-bean oil and passing air through it until gelatination sets in; oils, such as cotton-seed, ground-nut, or sesame oil, are then stirred in. The watery constituents of the emulsion may consist of water or milk and sugar, glucose, or other fermentable substances, which may contain vitamines and salts may be added. The fermentation of such substances is checked by the film of the water-dispersing medium surrounding the aqueous globules. The emulsion may be dissolved in a suitable fat or oil before adding to the margarine, etc. The water-dispersing medium may be added direct to the coconut oil or other fat from which the margarine etc., is to be made, or part of the medium may be so added and part added in the form of an emulsion. (Br. Pat. 178,885. E. V. Schou, Palsgaard, Denmark. June 21, 1922.)

Dephlegmating Column—A bubbling device for a rectifying or other column comprises a plate *A* having capped chimneys *B* for the passage of gases and one or more orifices *D* in the plate through which liquid descends to the next lower plate, the cross-section of the orifices being such that the liquid filling them adheres to their edges by capillarity. Delivery of liquid





through the orifices and the height of liquid on the plates vary according to the supply of ascending gas. A circular guide-wall may surround the cap *C*, and, in a further modification, the quantity of liquid required on a plate may be reduced by the formation of funnels *G* terminated at their lower ends by the orifices, the minimum height of the funnels being the distance *k* between the solid edge of the caps and the bottom *A* of the plate. (Br. Pat. 178,852. Not yet accepted. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude, Paris. June 21, 1922.)

Adhesives; Starch—An adhesive is made by treating potato starch paste with an alkaline or a neutral peroxide in presence of an alkali in a quantity insufficient for the production of soluble starch. Suitable per-salts such as persulphates, percarbonates and perborates or the peroxides of barium, calcium, magnesium, zinc or hydrogen may be used. Alkali carbonates or alkaline earth hydroxides may be added when neutral per-salts or peroxides are used. In an example, 100 kilos potato flour are mixed with 2½ kilos ammonium persulphate and 1 kilo ammonia solution of 22 deg. Bé. (Br. Pat. 179,765. A. G. Bloxam, 30 Southampton Bldgs., Holborn, London. July 5, 1922.)

Extracting Essential Oils — Essential oils and like volatile products are extracted from solid materials such as sandal wood, by means of a heated gaseous vehicle such as nitrogen or other inert gas or an unsaturated

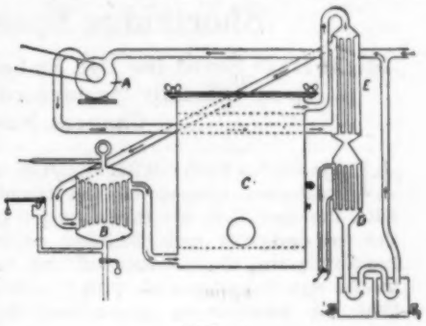


FIG. 1

vapor which is not condensed on cooling to separate the essential oil or by means of steam which is condensed in such a way as to generate a further quantity of steam for use in the extraction. In using an inert gas, the gas is circulated in a closed circuit through a heater *B*, Fig. 1, extraction-vessel *C*, heat-exchanger *E*, condenser *D*, pump *A*, and back through the heat-exchanger *E* and heater *B* to the vessel *C*. The heater may be formed as a jacket surrounding the vessel *C*, and containing a steam coil on an electric heater. Steam, when used, is passed through an extraction vessel *S*, Fig. 2, and to a condenser *E* which forms a vacuum evaporator, for example of the Kestner climbing-film type. The condensation of the steam and essential oil serve to generate steam at a lower pressure, which is compressed by a pump *C* and passed

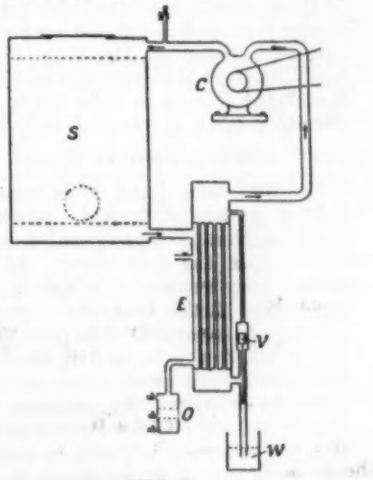


FIG. 2

into the extractor-vessel. The condensed water is separated from the essential oil in a vessel *O* and may be passed into the well *w* to be evaporated in the condenser. A float device *v* serves to maintain a definite level of water in the condenser. (Br. Pat. 176,104. F. L. Usher. Bangalore, India and E. P. Metcalfe, Hove, Sussex. April 26, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Shortridge Speech Came Too Late

Might Have Saved the Dye Embargo Had Results of Monopoly Probe Been Officially Announced in Advance of Senate Vote—Chances Now Are Against It

HAD SENATOR SHORTRIDGE of California acquainted the Senate with the fact that his investigation of the dye industry had disclosed no irregularity in the conduct of the domestic dye industry and with the fact that his painstaking probe had disclosed nothing approching a monopoly in this industry, before the vote on the embargo was taken rather than afterward, it is believed several votes which were cast against the embargo would have been registered for it.

The Senate investigation of the conduct of the dye industry was completed several weeks ago. No formal report as to the conclusions of the sub-committee, which conducted the investigation, has been submitted. There also has been a long delay in making available printed copies of the testimony taken at these hearings. While it had been assumed very generally that Senator Shortridge would report that no proof of monopoly or other wrong-doing had been disclosed, his statement made after the roll-call on the dye embargo was the first authoritative announcement of that conclusion. For that reason friends of the embargo are hopeful that the complete vindication of the domestic industry, which was announced in such a belated manner, will influence some of the Senators who voted against the embargo in Committee of the Whole to vote for it in the Senate proper in view of this finding.

Vote Likely to Stand

On the other hand it is recognized that it is very difficult to induce Senators to change their position after a record vote has been taken. It is admitted very generally in well-informed legislative circles that the chances are against a favorable vote for the embargo when a vote is had on Senator Frelinghuysen's amendment, which proposes to re-insert the embargo provision in the bill. If the President should use his influence actively in behalf of the embargo it is admitted that the chances then would favor its adoption by the Senate.

How the Senators Voted

Senators voting for the embargo when the Committee of the Whole rejected the Finance Committee's amendment were: Ball, Delaware; Brandegee, Connecticut; Bursum, New Mexico; Calder, New York; Curtis, Kansas; du Pont, Delaware; Edge, New Jersey; Ernst, Kentucky; Fernald, Maine; France, Maryland; Frelinghuysen, New Jersey; Gooding, Idaho; Hale, Maine; Jones, Washington; Ladd, North Dakota; Lenroot, Wisconsin; Lodge, Massachusetts; McCumber, North Dakota; McKinley, Illinois; McLean, Connecticut; McNary, Oregon; New, Indiana; Oddie, Nevada; Pepper, Pennsylvania; Phipps, Colorado; Rawson, Iowa; Shortridge, California; Sterling, South Dakota; Townsend, Michigan; Warren, Wyoming; Watson, Indiana, and Willis, Ohio.

Senators voting against the embargo were: Ashurst, Arizona; Borah, Idaho; Capper, Kansas; Caraway, Arkansas; Culberson, Texas; Cummins, Iowa; Dial, South Carolina; Fletcher, Florida; Harreld, Oklahoma; Harris, Georgia; Harrison, Mississippi; Heflin, Alabama; Johnson, California; Kellogg, Minnesota; Kendrick, Wyoming; Keyes, New Hampshire; King, Utah; McCormick, Illinois; Moses, New Hampshire; Nelson, Minnesota; Nicholson, Colorado; Norbeck, South Dakota; Norris, Nebraska; Overman, North Carolina; Pomerene, Ohio; Ransdell, Louisiana; Robinson, Arkansas; Sheppard, Texas; Shields, Tennessee; Simmons, North Carolina; Smith, South Carolina; Smoot, Utah; Stanley, Kentucky; Swanson, Virginia; Trammell, Florida; Underwood, Alabama; Walsh, Massachusetts; Walsh, Montana.

Twenty-six Senators did not vote, Most of them were paired, but two additional votes at least would have been cast for the embargo had they been present.

Carnegie Tech to Teach Metallurgy to Naval Officers

Carnegie Institute of Technology at Pittsburgh has been selected by the United States Naval Academy at Annapolis to give advanced courses in metallurgy to its graduate officers. Beginning next September, the Naval Academy will send two ordnance officers, graduates of the Academy, for a year's study in advanced metallurgy. Their studies will be confined principally to advanced metallurgy but will include some studies in electricity and physical chemistry. Other groups of graduate officers are assigned each year to various colleges or universities to study along specialized lines.

F. F. McIntosh, associate professor in metallurgy at Carnegie Tech, will supervise the studies of the naval officers. Lieutenants Gilbert C. Hoover and John H. Keefe have been assigned to take the work the next college year.

Says Dye Embargo Is Working Well

Dickson Describes Work of Treasury Department in Controlling Imports

In recent testimony before the House Appropriations Committee, F. S. Dickson, in charge of the dye and chemical section of the Treasury Department, referred to the work of the section in controlling dye imports.

The section bases reasonable prices on dyes upon the relation between the American cost of production and the American selling price, unless it can be shown that the cost of production abroad is comparable. It does not base a reasonable price upon the relation between the American and foreign prices. Mr. Dickson stated that for some articles of which there are small sales, moderately large profits are obtained.

Mr. Dickson said he had not found any profits in the dye manufacturing business in this country. About 10 per cent of the American consumption of dyes is imported. Because of the temporary tenure of the dye section it has been unable to determine whether the American industry is able to supply the domestic dye needs to the advantage of the manufacturer and consumer. He referred to the fact that the section is handicapped in having no laboratory.

Keeping Out Foreign Dyes

It was further testified by Mr. Dickson that the dye embargo so far has kept out foreign dyes. This year a total of 6,200 permits for importations of dyes have been issued for materials the domestic manufacturers could not supply. He had not observed a case of excessive charges, although suspicion had attached to one case and the price came down. He referred to the possibility of dyes being imported unlawfully through false billing which can be detected only by chemical analysis. Some imports have been checked at New York but have been found satisfactory. Ninety per cent of the imports are through New York, with a few through Boston and Philadelphia. The imports are largely from Germany and Switzerland, with a few from France and England.

Chemical and Engineering Societies Pledge Support to the Chemical Foundation

Federation's Committee on Procedure Asks Harding to Save Chemical Patents—Representatives of American Chemical Society Refused a Hearing at the White House

APPARENTLY the Department of Justice has lost some of the enthusiasm which characterized its initial activities against the Chemical Foundation. The administration is hearing from the country and at the White House inquirers are told that the Chemical Foundation case is a Department of Justice matter. Such an avalanche of protest has reached Washington that there is an entirely different attitude in evidence at the Department of Justice and at the office of the Alien Property Custodian, nevertheless there is no lessening of the determination to go ahead with the suits.

The announcements and statements made by officials of the Department of Justice and by the Alien Property Custodian's office indicate that the case against the Chemical Foundation is a legalistic structure in which more importance is attached to technicalities than to the fate of a great American industry. Apparently, the prosecuting officers launched into the case without a full understanding of it, as is indicated by the inaccuracies in their written and verbal statements.

Federated Engineers Appeal to President to Save Patents

That the Chemical Foundation enjoys the confidence of substantial interests outside of the chemical industry is indicated by the action of the Federated American Engineering Societies in adopting the following resolution:

> Whereas the President of the United States has ordered the Alien Property Custodian to recover that part of the patents formerly owned by enemies sold to the Chemical Foundation and
>
> Whereas these patents have become the nucleus of our American synthetic organic chemical industry which must be encouraged for scientific research, public welfare and national defense
>
> Therefore be it resolved that the Federated American Engineering Societies, through its committee on procedure, expresses the hope that no action will be taken without hearing representatives of chemists, chemical manufacturers, the medical profession and others most directly concerned and implores that nothing be done which can in any way or to the slightest extent tend toward the ultimate return to former owners of patents or other property lawfully sequestered and sold to Americans.

In announcing this resolution, Dean Mortimer E. Cooley of the University of Michigan and president of the Federated Engineering Societies emphasized the fact "that the Federated American Engineering Societies speaks concerning national problems for thirty-odd national, state and local engineering societies. The federation, therefore, speaks on behalf of some 55,000 engineers."

The Federation's Committee on Procedure includes Dean Dexter S. Kimball of Cornell, J. Parke Channing of New York, William McClellan of Philadelphia, and William E. Rolfe of St. Louis. Its chairman is Calvert Townley, vice-president of the Westinghouse company.

Told That "Chemists Had Too Many Committees"

So that the President might have the advantage of the views of a group of prominent men interested in the promotion of chemistry as a science, the American Chemical Society on July 12 sought an interview with the President for a committee which had been named. The request was followed up by telephone without result, and later a member of the committee called at the White House to inquire about it. He was told by the President's secretary that the chemists had too many committees. He apparently is of the opinion that since an interview had been granted to the committee headed by Dr. Herty, this should be sufficient. The secretary's attention was called to the fact that the interest of the American Chemical Society is different from that of the manufacturing chemists.

This attitude was confirmed on the following day by the receipt of a perfunctory statement from the President's secretary to the effect that the President is too busy with the coal strike to arrange to receive the committee from the American Chemical Society. In view of the fact that he is receiving a great many other persons, the reply is not entirely satisfactory.

Intentions of Committee

Had the American Chemical Society committee been granted an interview it was the intention of its members to tell the President that, so far as they have been able to learn, the purposes of the Chemical Foundation are laudable and that it has been conducted without irregularities. A representative of the chemists' committee had listened to a two-hour explanation of the position of the Department of Justice without having elicited any information as to illegal conduct on the part of the Foundation. In view of those facts, President Harding was to be asked if he had any information which he could impart to them, in confidence if necessary, which would indicate that the society is wrong in placing its support behind the Chemical Foundation. The members of the committee had hoped to tell the President that, in the light of all the information they have been able to gather, they can see no reason for this blow dealt to research.

Personnel of Committee

The Chemical Society's committee is composed as follows: Edgar F. Smith, president American Chemical Society and former provost of the University of Pennsylvania; John E. Teeple, consulting chemist of New York City and treasurer of the American Chemical Society; Julius Stieglitz, of the University of Chicago and former president of the American Chemical Society; William Hoskins, consulting chemist of Chicago; E. R. Weidlein, director of the Mellon Institute of Industrial Research; Arthur D. Little, past president of the American Chemical Society and of the American Institute of Chemical Engineers, and a member of the corporation of the Massachusetts Institute of Technology; J. F. Norris, professor of organic chemistry at the Massachusetts Institute of Technology; R. H. McKee, professor of chemical engineering at Columbia University and past chairman of the New York section of the American Chemical Society; George D. Rosengarten, member of the national policy committee of the American Chemical Society, and H. E. Howe, editor of the *Journal of Industrial and Engineering Chemistry*.

Atmospheric Pollution Litigation Held in Abeyance

Although one of the cases was decided many years ago and the other was filed six years ago but not prosecuted, the U. S. Supreme Court continues to maintain on its docket two chemical cases of general interest. One of these is the State of Georgia vs. the Tennessee Copper Co., involving smelter fumes. This case was decided by the court more than a dozen years ago and the company was required to prevent the destruction of vegetation through further exhaust of fumes. The court retains the case on its docket from year to year, however, on the ground that it does not care to lose jurisdiction in the matter should any new developments arise in the situation.

The other case is that of the State of New York vs. the Bulls Ferry Chemical Co. of New Jersey, which was filed by the state in the court on March 11, 1916, but which has never been prosecuted. In this case the State of New York sought to restrain the operation of a factory of the chemical company at Edgewater, Bergen County, N. J., on the ground that the fumes, smoke, gases and other vapors emitted by the plant are offensive, obnoxious and destructive to New York, principally the residential district on Riverside Drive.

The constitutionality of the federal water power act in its application to state streams, brought by the State of New York just before the last term of court adjourned, will be carried over on the docket for the new term beginning in October.

New York University Offers Courses in Raw Materials

New York University announces two new evening courses in the geology of commerce and finance beginning this fall. The purpose of the courses is to acquaint the student with the fundamental facts underlying our mineral and raw materials situation. The character and source of supply, the methods and cost of preparing them for market and their relation to other lines of business will be discussed in a series of lectures. The subjects will include building stone, lime and cement, brick and tile, water supply, sulphur and pyrites, salt, borax, fertilizer fuel and power.

Ernest R. Lilley, the lecturer, is an experienced geologist and mining engineer and one of the best informed men in the country on the economic problems of the raw material industries.

The second term, beginning in the spring, will cover the more complex problems of the metal industries. The lecturer will divide his subject into four main divisions—the iron group, the non-ferrous metal group, the precious metals, and the process minerals. Because of the special problems involved in preparing these materials for the market, stress will be laid upon the nature and cost of smelting and refining.

Alpha Chi Sigma to Reorganize Alumni

At the seventh biennial conclave of Alpha Chi Sigma, the professional chemical fraternity, held recently in St. Louis, a plan was adopted for the organization of the alumni into professional groups. This reorganization had been looked forward to since the previous conclave of 1919, at which time the old scheme of alumni organization was discarded and the various alumni groups were asked to form, test out, and report at the next conclave their various plans for reorganization.

The plan accepted is a compromise on the various plans submitted and it is believed the first step has been taken toward the organization of professional groups to replace the previous alumni chapters.

The following officers were elected for the next two years: President, Dr. Stroud Jordan, Brooklyn, N. Y.; vice-president, Dr. Robert Burns, New York City; secretary-treasurer, A. L. Davis, Wood River, Ill.; National Alumnus, L. J. Trostel, Bureau of Chemistry, Washington, D. C.; editor of *Hexagon*, John R. Kuebler, Indianapolis, Ind.

Chemical Warfare and Muscle Shoals Appropriations

Construction work, at a cost of $262,000, for the Edgewood Arsenal of the Chemical Warfare Service and also for Camp Lewis, Washington, is authorized by the War Department appropriation bill passed by Congress and approved by the President.

The Chemical Warfare Service also receives $17,240 for administrative expenses and $600,000 for investigations.

For construction of Dam No. 2 at Muscle Shoals, Ala., $7,500,000 is appropriated, but it will not be available until October 1.

Preliminary Program for A. I. M. E. Meeting

Society Will Journey to Coast by Special Train, Picking Up Members En Route

A preliminary program of the 126th meeting of the American Institute of Mining and Metallurgical Engineers has been announced. The meeting is to be held in San Francisco, Sept. 25 to 29.

A party including President and Mrs. Dwight will be made up in the East. It will pass through the central western and northwestern states, and, it is hoped, will be joined by members from those states. The party will arrive in San Francisco on Sept. 24.

Monday, Sept. 25, will be devoted to technical sessions which will be held at the Engineers Club and there will be as many sessions as may be required to present the papers available. Owing to the lateness of announcing the meeting in San Francisco, several papers that should be presented at this meeting will not be prepared in printed form for distribution prior to the meeting.

The following day, a party limited to 50 men will leave for Hetch Hetchy, San Francisco Water Project, under direction of M. M. O'Shaughnessy, Chief Engineer. Those not taking this trip will visit a number of interesting points in the vicinity of San Francisco. These trips will occupy four days up to Sept. 30, when the party will take the train for Los Angeles. The program provides for a one-day stop in this city and in Kingman, where the mines and mills in the vicinity will be visited. The return trip allows for stops at the Grand Canyon, the Roosevelt Dam and the Apache Trail.

Among the papers to be presented are the following:

"Deposition of Copper Carbonate from Mine Water," by P. D. Wilson.

"Surface Tension and Adsorption Phenomena in Flotation," by A. F. Taggart and A. M. Gaudin.

"Conditions of Stable Equilibrium in Iron-Carbon Alloys," by H. A. Schwartz, H. R. Payne, A. F. Gorton and M. M. Austin.

"Neumann Bands as Evidence of Action of Explosives on Metal," by F. B. Foley and S. P. Howell.

"Effect of Nickel Chromium on Cast Iron," by Richard Moldenke.

"Shot Firing by Electricity," by N. S. Greensfelder.

"Automatic Electric Regulation of Ball-mill Feed," by B. H. Smith.

"Heating and Cooling Curves of Large Ingots," by F. E. Bash.

"Electrochemical Process for Treatment of Copper and Other Ores," by Henry S. Mackay.

"Industrial Relations in California Petroleum Industry," by Roy W. Kelley.

"From Drill to Service Station—The Story of Oil in California," by Roy W. Kelley.

"Mining Iron Ore in the Adirondacks," by John E. Hodge.

Societies Will Meet at Chemical Exposition

The next regular meeting of the recently organized Technical Photographic and Microscopical Society will be held in conjunction with the Eighth National Exposition of Chemical Industries during the week of September 11 to 16 at the Grand Central Palace, New York, on Thursday, September 14. In addition to meeting, the organization has already made arrangements for the display and explanation of the work of individual members in technical photography and photomicrography, with its application to the everyday problems of the chemical or chemical consuming plant. A booth at the exposition has been reserved for the purpose.

Other associations, announcement of whose meetings in conjunction with the Chemical Exposition has already been made, include the Salesmen's Association of the American Chemical Industry, the American Ceramic Society and the Technical Association of the Pulp and Paper Industry. Later announcements of the programs of these societies will be made.

Powdered Coal for St. Louis Power Plant

Recommended as a Means of Guarding Against the Emergencies of Future Coal Strikes

Decision to burn powdered coal in the new $6,000,000 power plant of the Union Electric Light & Power Co. of St. Louis has been announced by the company's engineers, McClellan & Junkersfeld, Inc.

Extensive tests and investigation on stoker equipment and pulverized fuel equipment proved that coal in powdered form was a most desirable fuel, giving more economical results than any other type of combustion equipment and permitting the use of mine sweepings, low grade and non-marketable coals, which are often wasted.

The possibility of using such waste coals is of very great advantage, from the standpoint of economy. The burning of powdered coal is as simple as the burning of fuel oil, has many of the advantages of this fuel, and, in an emergency due to miners' strikes or other unforeseen causes, fuel oil may be used in the same furnaces without change.

The new plant, of which 60,000 kw. will probably be in operation next year, will have an ultimate capacity of 240,000 kw., and is to supply the rapidly increasing industrial and lighting load in St. Louis, in addition to that now being supplied from the Keokuk dam and from an existing large steam plant.

Petroleum Committee Conference Amends Gasoline Specifications

The Interdepartmental Petroleum Standards Committee of the Government held an open conference in Washington, July 3. At that time the committee was again urged to amend the government specifications for gasoline by increasing the "end-point" of the distillation test. It was urged by some others in attendance that the demulsibility test also be modified, or for some products eliminated from the specifications. Numerous other changes of detail were also proposed. The committee will take these matters under advisement at an executive meeting to be held in the very near future after which the results of their deliberations will be announced. As in the past, the specifications recommended by this committee will undoubtedly be the official basis for government purchases. For that purpose they require approval of the Federal Specifications Board but this approval will doubtless be granted promptly, as the committee represents all of the interested departments.

New Chemical Companies

Fewer companies for the manufacture and distribution of chemicals, dyes and drugs were organized during June than in any month since May, 1921, according to the compilations of the New York *Journal of Commerce*. The total indicated investment of the nine new companies was $2,600,000, which compares with an aggregate of $3,671,000 for the twenty companies organized during May, 1922. The record for the present year was made during January when an investment of $37,650,000 was indicated.

The names and indicated investment of the nine companies formed during the month of June are as follows:

Carrier Chemical Co.	$150,000
Eckhardt Medicine Co.	50,000
Herchris Corporation, The	750,000
Pacific Ammonia & Chemical Co.	300,000
Pollack (Dr.) Health Products Corporation	100,000
Pennsylvania Pharmaceal Co.	100,000
Schwartz Drug Co.	100,000
Standard Flexible Compound Co.	1,000,000
Wix (W. J.) & Sons Co., Inc.	50,000
Total	$2,600,000

Air Reduction Co. to Manufacture in Birmingham

Announcement is made that the headquarters, office and plant of the Air Reduction Sales Co. will be removed from Atlanta, Ga., to Birmingham, and that a $250,000 plant will be erected in North Birmingham, where gases and equipment for the oxyacetylene welding and cutting will be manufactured.

The site for five of the buildings has already been purchased and consists of three and one-half acres at Twenty-ninth Ave. and Twenty-fifth St., North Birmingham. The products of the concern will consist of oxygen, acetylene, nitrogen, argon and other atmospheric products, welding and cutting apparatus and supplies, acetylene generators, and specially designed machines for welding and cutting.

L. B. Allen, field representative, will arrive in Birmingham within a few days to begin construction of temporary buildings.. The permanent plant is expected to be completed by January 1, although it is stated that the concern will be in operation in two or three months, as soon as the temporary buildings are ready. The plant will be in charge of H. G. Boyer, district sales manager.

Arsenic Tariff Causes Senate Flurry

Southern Senator Accuses Smelting Interests of Attempting to Profit Unduly at Expense of Boll-Weevil Sufferers

Although a duty of two cents per pound on white arsenic had been approved by the Senate over two weeks ago, the subject was reopened on July 21 when Senator Smith of South Carolina made the startling charges that this tax on insecticide users was made in order to increase the profits of the smelting interests, principally those of the Guggenheims.

"To date," said Senator Smith, "the Department of Agriculture has spent something like $12,000,000 to find some method of checking the boll weevil, the ravages of which insect to a great extent remain unchecked. Now we have some hope in the application of calcium arsenate and the Senate votes a tax that will add 50 cents per acre for every acre poisoned. There are 35,000,000 acres of cotton land in the South and if it were possible to poison all of these fields, this would mean an added cost of something like $17,000,000."

The Insecticide and Disinfectant Manufacturers Association of New York City brought the arsenic duty to the attention of Messrs. Underwood, Smith, Simmons and other Southern Senators. The association estimated that 16,000 tons of arsenic would be needed this year to supply the demand of cotton planters and orchard owners, and that the shortage would be 3,000 tons. The greatest annual production in this country on record is 11,500 tons. Japan is the principal source of the imported arsenic.

Smoot Defends Duty

Senator Smoot challenged the statements of the Carolina Senator, declaring that the greatest amount of arsenic, including that imported, ever disposed of in this country in one year was 20,000,000 pounds, and, therefore, in order to add a burden of between $17,000,000 and $18,000,000 to the poisoning cost, it would be necessary, he said, to use up 90,000,000 pounds of arsenic. The difficulting in reconciling these figures is due, of course, to the fact that Senator Smith's very enthusiastic estimates were based on calcium arsenate tonnage, while Senator Smoot had in mind white arsenic, As_2O_3.

Farmers Using Excess Picric Acid Stocks

That the farmers of the country have not been slow to avail themselves of the opportunity to obtain a good agricultural explosive at a low cost is shown by the fact that in the fiscal year ending June 30, 1922, 3,264,700 lb. of picric acid has been distributed by the Bureau of Public Roads, U. S. Department of Agriculture. Originally about 12,000,000 lb. of picric acid was available as a surplus of war stocks. A considerable amount has been used for road building purposes and there now remains about 5,500,000 lb., practically all of which is located at Wingate, New Mexico. A study of the distribution figures during the past year shows that Minnesota, Wisconsin and Michigan took by far the largest amounts, Minnesota alone taking 1,091,300 lb.

High freight rates and long shipping distances have operated adversely. The unfavorable financial situation in the South also is reflected in the distribution figures. Some twenty states have agree to carry on the distribution during the present fiscal year. The picric acid is being distributed in most cases through the Extension Services. The cost to the farmers is 7 cents per lb. for cartridging and loading plus the freight charges.

Engineering Societies Ask Opinion on Depreciation Regulation

In a letter to the Secretary of War, L. W. Wallace, the executive secretary of the Federated American Engineering Societies, asks what has happened to the appeal of the electrical industries against the depreciation regulation drafted for use in connection with the waterpower act.. Mr. Wallace's letter reads as follows:

"For many months, there has been pending before your Commission an appeal from the electrical industries against the depreciation regulation which it was proposed to enforce in the administration of the waterpower act.

"Many of the engineers who compose this organization are particularly anxious to see our waterpower resources utilized as extensively and as promptly as is possible, and some of them have requested that I secure an authoritative statement as to the status of the matter. There is a feeling that the uncertainty in regard to depreciation is tending to retard this development.

"May I inquire what are the prospects for action on the depreciation regulation? It would be very helpful to our members if we could have the advantage of any personal views on the subject which you may care to express."

Fertilizer Contracts Are Declared Binding

Drop in Price of Nitrate of Soda Involves Losses to Both Farmers and Fertilizer Companies

Contracts made by Georgia farmers with fertilizer companies in 1920 for subsequent deliveries of nitrate of soda are binding, according to the State Court of Appeals. A test case was being brought through the courts and will now be appealed to the Supreme Court of Georgia.

The controversy between farmers and fertilizer companies developed early in 1921. The farmers had placed orders the previous year for nitrate of soda to be delivered in January, February and March, 1921, at $84 per ton. At the time of delivery the market price had dropped to $50, and farmers throughout the Southern States refused to pay the difference. Consequently many suits to recover the difference claimed by the fertilizer dealers were filed. The farmers claim that their loss amounts to $3,000,000. In reply to this, Russell Porter, of Atlanta, president of the Southern Fertilizer Association, issued the following statement:

"The fact is, the contract involved in this suit is the one under which the fertilizer manufacturers of Georgia lost millions of dollars by reason of carrying out their obligations.

"This is only one of the many contracts for fertilizer materials on which the fertilizer manufacturers lost so much money."

Would Repudiate Government Interest in Reparation Dyes

Senator King, of Utah, has introduced a resolution expressing the sense of the Senate that the State Department should annul and cancel any authority on the part of any representative of the United States or other persons to deal with the Reparation Commission "respecting the purchase and importation of reparation dyes into the United States."

The resolution also suggests that the State Department advise the Reparation Commission that the United States Government has no concern with the purchase of reparation dyes for importation into the United States, and that "neither the Textile Alliance, Inc., nor Roland W. Boyden has any authority to negotiate with the Commission on behalf of the government of the United States concerning the purchase and importation of reparation dyes for sale in the United States."

The resolution is prefaced by nine "whereases," in which it is charged that the Textile Alliance has carried on propaganda to mislead Congress into the belief that the government has valuable interests and rights in and to the dyestuffs received from the Reparation Commission from Germany. The King resolution declares that the United States Government has no interest in the reparation dyestuffs, no rights with respect to the proceeds of the sale of such dyestuffs and no interest in the purchase of such dyes for sale in the American market. The resolution charges that the Textile Alliance has made profits of $2,000,000 in traffic in reparation dyes and repudiates the claims of the Alliance for exclusive agency for the purchase and importation of these dyes.

Plans Dye Tariff Amendments

Senator King has announced that he will offer a thousand amendments to the chemical schedule when that section of the revised tariff bill is taken up for final action. He indicated however, that he will debate only a part of these amendments.

Potash Bounty Proposal May Be Extended

The decision of the Senate Finance Committee to put a bounty on potash to replace the proposed duty has caused much discussion of the advisability of extending the plan to other commodities. Some are of the opinion that it could be applied successfully to manganese and other commodities where there is no early opportunity of developing domestically more than a fraction of the country's requirements.

While the sugar bounty, put into effect by Congress in 1890, was unpopular, it was not discontinued for that reason but because sugar is an ideal source of customs revenue, since the tax is distributed to every resident of the country.

In the case of potash, a duty means that the tax will be paid largely by the farmers. A bounty will cost less and will allow that lesser burden to be divided equally among all taxpayers. In the case of manganese, the situation is somewhat different. The tax at the Custom House would fall largely on the steelmakers. In their industry, however, it is comparatively easy to pass the tax on. This means it will be collected ultimately from the construction industries. The tariff makers are particularly anxious to encourage these industries and are trying to avoid adding to their burdens any more than is necessary. This is one of the reasons for the very determined opposition to high rates on ferroalloys. A bounty would distribute the tax better, it is admitted, but the Finance Committee hesitates at launching too heavily into a bounty policy.

Opposition to Potash Duty

Representative Goldsborough, of Maryland, opposing the proposed duty on potash, declared it to be "worse in principle than the ship subsidy. It proposes to subsidize the producers of potash and to make the American farmer pay the tribute to the tune of about $51,350,000 a year."

Mr. Goldsborough gave an extended statement of the American Farm Bureau Federation in opposition to the potash duty.

Civil Service Opening

Competitive examinations are announced by the U. S. Civil Service Commission for Junior Chemist at a salary of $1,200 to $1,800 per year.

Application for this position should be made on form 1312.

Personal

F. L. Childs will continue as sales manager of the Heyden Chemical Co., New York City, following the recent reorganization of the company.

S. F. Cox, formerly assistant to the consulting engineer of the Pittsburgh Plate Glass Co., has accepted a position with the Calorizing Co. of Pittsburgh, Pa., as chief engineer. He will have direct charge of the Wilkinsburg, Pa., plant, in addition to other duties.

Philip DeWolf, who has been doing consulting chemical engineering at Westport, Conn., has become associated with the industrial real estate concern, Louis Schlesinger, Inc., of New York City and Newark, N. J. Mr. DeWolf will specialize in industrial and factory real estate.

Thomas French, formerly of Welland, Ontario, Canada, has undertaken the construction of a plant at Albany, N. Y., for some metallurgical products. His address at the present times is 363 Edgecombe Ave., New York City.

General Amos A. Fries, head of the Chemical Warfare Service, recently underwent an operation for appendicitis. He is recovering rapidly and expects to be at his desk again before the end of the month.

Dr. George F. Richmond of Antoine Chiris Co., Delawanna, N. J., has been appointed chairman of the nominating committee of the New York Section of the American Chemical Society. Other members are Dr. J. E. Zanetti and S. D. Kirkpatrick.

Julian F. Smith, formerly a member of the research staff of the National Aniline and Chemical Co., Buffalo, N. Y., has accepted a position with the Commercial Solvents Corp., Terre Haute, Ind., to become effective Sept. 1. Mr. Smith will have charge of the research and information service.

Ernest T. Trigg, an official of John Lucas & Co., Inc., Philadelphia, Pa., manufacturer of paints and varnishes, and president of the National Paint, Oil and Varnish Association, gave an address before the first Pacific Coast regional convention of the latter organization, Portland, Oregon, on July 13.

George S. Weith has obtained an indefinite leave of absence from the Redmanol Chemical Products Co. to recuperate from sickness.

Dr. Gerald L. Wendt resigned on July 1 as associate professor of chemistry at the University of Chicago to join the staff of the Standard Oil Company of Indiana in the direction of research.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Car Loading as an Index of Distribution

Production and Consumption of Commodities Are Normally Reflected in the Week-to-Week Changes in the Loadings of Revenue Freight

IN NORMAL TIMES the trend of business movements may be conveniently and accurately followed by observing the changes in the number of freight cars loaded during a certain period. Especially when this figure is studied in connection with statistics of production, is it possible to interpret it in terms of distribution and stocks. In other words when the volume of manufacture exceeds car loadings, stocks are usually piling up. On the other hand an excess of loadings means that distribution is going ahead of production, generally at the expense of lower commodity stocks.

Car loadings also have a qualitative significance in showing the kind of commodities that are entering into consumption. Thus it will be recalled that just before the coal strike started on April 1 there was unusual activity at the mines. March showed abnormally higher coal loadings which favorably affected the total for revenue freight. In April shipments of coal dropped off tremendously and there was a noticeable decline in car loadings during that month. Since that time and in spite of the coal strike there was an increase during both May and June—a very encouraging development as affecting the general commodity situation.

On July 21 the American Railway Association issued its report for the week ended July 8, which was the first since the beginning of the shopmen's strike. The total showed a reduction of 158,577 cars as compared with the last week of June, but 77,784 more than for the corresponding week in 1921. It was less than that in the first week of July, 1920, by almost exactly the same number. It should be pointed out, of course, that some reduction might ordinarily be expected because of the intervention of the holiday on July 4.

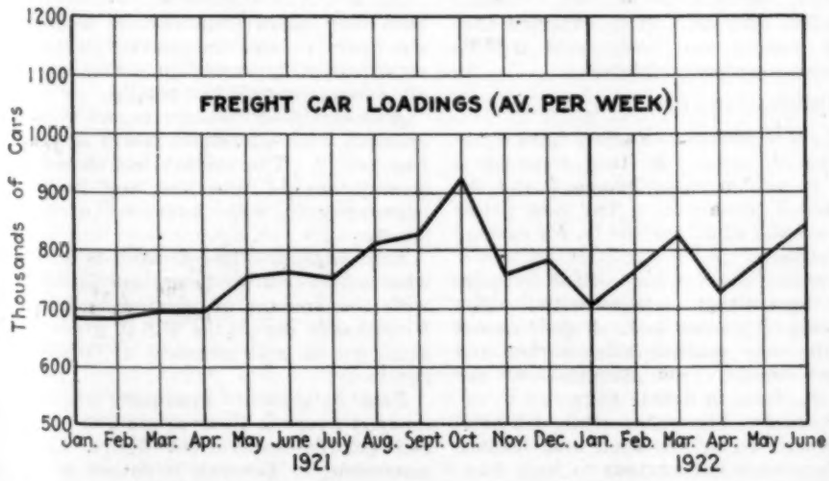
Coal loadings showed a decrease of 68,996 cars, a decrease from the preceding week of 25,752 and a decrease of 54,974 as compared with the same week of last year.

Merchandise and miscellaneous freight, which also includes manufactured products, totaled 482,079 cars, a decrease of 93,067 cars as compared with the previous week and an increase of 89,286 cars over the same week of 1921.

Loadings of revenue freight since the first of the year are compared with the corresponding periods of 1919, 1920 and 1921 in Table I.

TABLE I. CAR LOADINGS OF REVENUE FREIGHT, BY WEEKS SINCE JANUARY 1, 1922

	1922	1921	1920	1919
July 8	718,319	640,535	796,191	809,847
July 1	876,896	776,079	891,621	743,226
June 24	877,856	775,447	911,503	845,684
June 17	860,722	775,278	916,686	807,907
June 10	846,002	787,283	930,976	807,205
June 3	750,645	693,903	828,907	776,610
May 27	821,121	795,335	898,169	763,761
May 20	792,459	770,991	862,074	777,330
May 13	777,359	751,186	843,155	139,945
May 6	755,749	721,722	843,184	753,025
April 20	758,286	721,684	800,960	751,997
April 22	714,988	704,632	717,777	715,027
April 15	706,713	702,116	601,695	705,996
April 8	714,268	694,881	801,559	710,720
April 1	827,001	663,171	858,827	688,567
March 25	846,035	686,567	895,386	713,275
March 18	823,369	691,396	855,060	699,720
March 11	829,128	700,440	819,329	701,266
March 4	803,255	711,367	811,166	675,270
Feb. 25	735,286	659,242	183,295	666,708
Feb. 18	780,924	692,007	772,102	700,913
Feb. 11	788,412	687,867	786,633	687,128
Feb. 4	753,886	699,718	762,680	692,614
Jan. 28	743,728	701,605	893,332	718,297
Jan. 21	738,275	708,658	804,866	734,293
Jan. 14	720,877	715,855	840,524	758,669
Jan. 7	605,992	697,611	830,073	723,801



WEEKLY CAR LOADINGS OF REVENUE FREIGHT BASED ON REPORTS FROM THE RAILROADS OF THE U. S. BY THE CAR SERVICE DIVISION OF THE AMERICAN RAILWAYS ASSOCIATION

The Arsenic Situation

During the last few weeks there has been an acute shortage of both white arsenic and calcium arsenate. Usually the arsenic season extends from November to March but this year there has been an abnormal demand from the insecticide consuming districts, particularly in the cotton growing regions. The use of calcium arsenate in combating the boll weevil was largely brought about through governmental research and it is perhaps natural that the cotton growers have been appealing to the federal and state governments for help in meeting the situation caused by the shortage of these materials. The Georgia State Department of Agriculture is reported to have created a revolving fund with which to buy calcium arsenate and distribute it at cost to farmers in that state. A contract secured early in the year at 9c. per lb. has been disposed of and the supply is said to be running short. Farmers in many of the other states are reported to be facing as serious a situation and this scarcity is already evident in the arsenic market.

While the abnormal demand from the insecticide trade is doubtless the principal cause for the arsenic shortage, there are a number of contribut-

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	153.58
Last week	154.65
July, 1921	148
July, 1920	274
April, 1918 (high)	286
April, 1921 (low)	140

For the third consecutive week this index number has declined. This is probably attributable to the seasonal inactivity of the chemical market rather than to any broad market movement. Lower prices for caustic soda and linseed and cottonseed oils were responsible for this week's decline.

ing factors. The reduced output of copper (and consequently of domestic byproduct arsenic), and the decrease in imports from Mexico and Japan are most important. Neither Germany nor England have been a factor in the arsenic market for at least 6 years.

PRODUCTION AND CONSUMPTION

The maximum annual consumption of white arsenic in the United States was in 1920 when it was estimated that approximately 15,000 tons were used. In 1921 this dropped to not more than 9,000 tons. It is difficult to estimate the amount of white arsenic consumed in the United States because of its wide variance—from 3,400 tons in 1904 to 15,000 in 1921. The following figures, estimated by a leading factor in the industry, are believed to be as accurate as are available:

	Tons
By the glass manufacturers	2,500 to 3,000
Sheep and cattle dips, approximately	1,500
For dyes, pharmaceutical and other purposes, approximately	500
In the manufacture of lead and calcium arsenates, insecticides, and weed killers, approximately	5,000 to 9,000

Prior to 1914 by far the larger share of arsenic used in this country was imported. From 1901 to 1910 the United States produced only an average of about 975 tons, while imports averaged 4,235 tons. Production from 1911-1920 is given by the Geological Survey as follows:

Year	Quantity (Short Tons)	Value
1911	3,132	$73,408
1912	3,141	190,757
1913	2,513	159,236
1914	4,670	313,147
1915	5,498	302,116
1916	5,986	555,187
1917	6,151	1,118,313
1918	6,323	1,213,000
1919	6,029	.....
1920	11,500	.....

Conflicting Views on Labor Troubles

Economists, as well as doctors, often differ in their diagnostics. Industrial ills are now a fitting subject of study and they are being approached from many different angles. Two outstanding groups of economic students have recently offered views on the labor situation, which at first glance might seem to be at considerable variance. Underlying both, however, is the firm belief that present labor difficulties are but a temporary deterrent to continued industrial progress.

In the following paragraph quoted from a recent letter of the Harvard Economic Service, a striking parallel is shown by a comparison of industrial conditions in the fall of 1919, with those of the present.

> Labor trouble is the darkest cloud upon the present business horizon. Seldom has the country ever faced as many serious strikes as at the present time. The situation in this respect bears a strong resemblance to the fall of 1919. Numerous strikes at that time—those in the steel and soft coal industries being the most important—restricted output at a time when it otherwise would have expanded rapidly. * * * It will not be surprising if this episode is repeated in 1922. As yet, however, current output has manifested little retardation. Unless the existing labor difficulties are of unusual duration or spread to other industries, like interstate transportation, no general loss of industrial pace is to be expected.

Roger Babson, on the other hand, points out in one of his recent barometer letters that there is an evident tendency at the present time to overestimate the significance of labor difficulties. "The labor situation is by no means as bad as it seems," he declares. "The coal and railroad strikes make spectacular news and, of course, are important. Taken as a whole however, the labor situation is very much improved. At present we have a few large strikes, whereas during the last few years we have had a number of small strikes."

Mr. Babson then refers to a chart "which shows that in actual number there are fewer strikes in progress than during 1917, 1918, 1919 or the greater part of 1920. Considering that spring and summer are the 'strike seasons' the current year's record is the most favorable since 1915."

The New York Market

NEW YORK, July 24, 1922.

Trading in the chemical market during the past week has been unusually quiet, due presumably to adverse conditions existing in several leading industries. Difficulties on the railroads, tariff reversals and labor troubles have added to the severe strain on the chemical industry. The chief demand at present is for small lots, with larger quantities commanding little attention. The export situation for alkalis has not shown any unusual strength and trading has been along very limited lines. The market in several commodities has uncovered some strong features, with white powdered arsenic and sulphate of ammonia showing most improvement. Manufacturers of lime acetate announced another increase effective July 22. It is expected that both acetone and acetic acid will be advanced proportionately.

GENERAL AND SPECIAL CHEMICALS

Acetate of Lime—Factors have again advanced prices on this commodity, due to the increasing demand and the curtailed production. The new prices are around $2.35 per 100 lb. for carload quantities.

Ammonium Sulphate—Spot supplies are exceedingly scarce with sellers offering only small lots. A good export inquiry has reached this market and prices ranged from $3.55@$3.60 per 100 lb., f.a.s. in double bags.

Arsenic — The prime white material is much firmer on spot and leading dealers were not anxious to book business at under 8c. per lb. Demand from the insecticide trade continues unabated. Foreign shipments have been delayed as much as three months, causing a pronounced shortage in the spot market. Prices ranged from 8@8½c. per lb.

Barium Chloride — Spot goods were rather easy during the interval and sellers named prices around $90@$95 per ton. Shipments from abroad were held at $85 per ton, c.i.f. New York.

Bichromate of Potash — Round lots were sold down to 9½c. per lb. Smaller transactions were heard up to 10c. per lb. Buying has been very quiet in this product during the past week.

Caustic Soda — Export business has been somewhat slow, with a few sales noted at $3.55 per 100 lb. The general range is from $3.55@$3.60 per 100 lb., f.a.s. Domestic material is moving moderately at $3.75 per 100 lb. ex store.

Hyposulphite of Soda—Domestic factors report sales for regular crystals at 3c. per lb. Pea crystals are quoted at $3.50@$4 per 100 lb. The demand is fair.

Nitrite of Soda — There has been very little improvement in demand during the past few weeks in this product. Resale lots are being quoted at 8@8½c. per lb. Producers' figures are unchanged at 9c. per lb., f.o.b. works.

Prussiate of Potash — The yellow variety was fractionally lower at 31½c. per lb. for limited quantities. Shipments from abroad are held around 30½c. per lb. The red material is unchanged at 90c. per lb.

Soda Ash—Leading sellers have not changed their prices and quote $1.75 per 100 lb. for single bags, in carload lots, and $1.90 in barrels. Producers report a firm market for contract requirements.

COAL-TAR PRODUCTS

There have been no unusual features in this market during the past week. Business has been moderate with the general demand for small lots. Lower prices were reported for dinitrochlorbenzene and alpha naphthylamine. Crude products have continued to show strength with no special price changes reported.

Alpha Naphthylamine — Inquiries have been heard from various consuming quarters and the market is in a very promising condition. Small lots are moving at 28@30c. per lb.

Aniline Oil—Producers report a fair demand, with quotations heard around 14c. per lb. The market has shown a steady tone of late and any buying improvement will advance present levels.

Benzaldehyde—The demand is somewhat active and producers are satisfied with the amount of passing business. First hands report the U.S.P. grade at $1.25 per lb. and technical at 60@70c. per lb.

Beta Naphthol — Producers are not inclined to shade their prices and quote 24c. per lb. as the low figure. The movement, in general, is rather quiet, with competition keen for any new business. Some small lot sales through second hands were transacted at prices as low as 22c. per lb.

The St. Louis Market

ST. LOUIS, MO., July 20, 1922.

There have been no important developments during the past two weeks in this market and the actual business transacted has been on a par with the corresponding period of last month. The usual summer lull has not gained its full sway as in past years. Price changes have been very few and the general tone of the market is firm. Imports have not been so numerous, with the result that there has been a very heavy demand for certain domestic commodities. One of the groups which is very prominent at this time is the insecticides, and also the chemicals used in their manufacture.

GENERAL AND SPECIAL CHEMICALS

The alkali market has recently been thrilled with the oft repeated post war cry, "Open prices openly arrived at." Two of the largest manufacturers having adopted the novel scheme of displaying their complete price schedules. These prices for St. Louis are as follows: *Soda ash* in bags, $2.19 per 100 lb.; in bbls., $2.43 per 100 lb. for 58 per cent light. *Caustic soda*, solid, $3.90, flake $4.39, basis 76 per cent. *Bicarbonate of soda*, bbls., $2.35; kegs, $2.60 per 100 lb. These prices are for truck load quantities f.o.b. buyers' door. Smaller quantities sell at a reasonable advance. We believe that these prices will be generally adhered to. *Sal soda* is rather quiet with prices steady.

The whole situation on heavy mineral *acids* is very good today with several advances in *sulphuric*, also in *hydrochloric*. The *citric-acid* situation has eased and spot stocks are more easily obtainable. *Oxalic acid* continues to stiffen, with makers quoting from 12½@16c. per pound, occasional buyers having difficulty in locating spot stock. *Tartaric acid* while doing very well a month ago has slowed up a trifle. There is still a scarcity of *white arsenic* with the demand good and the market strong, prices being quoted at 8c. f.o.b. New York. *Carbon bisulphide* continues to be in heavy demand from the agricultural centers. Due to the present condition of the steel mills there is again a scarcity of *copperas*, and quotations are firm. *Glycerine* has taken another sharp advance and is firm at 15½c. in drums with producers completely in command. As a matter of fact they are somewhat reluctant about new business and are apparently sold to capacity for some time to come. While there is a regular but limited demand for *potassium cyanide*, the smallness of stocks is not noticeable. *Photographic chemicals* are showing a steady improvement, and a nice volume of business is being done. *Sulphur* is still going at about the same pace with no noticeable change in price or volume of movement. *Zinc dust* has been very quiet, but in sympathy with spelter has recently advanced from ½ to ¾c per pound. Stocks of *zinc spelter* have been reduced over 50 per cent during the last thirty days, and actual supplies available at this time are less than thirty days. The market is very strong and is around $5.80 per 100 lb. *Zinc sulphate* continues to be very strong and has sharply advanced, now being quoted $2.75@2.85 per 100 lb. carload lots f.o.b. St. Louis.

VEGETABLE OILS AND NAVAL STORES

Turpentine went as low as $1.21 in single barrels, but is now on another rebound and commands $1.32 per gallon. *Linseed oil* is very quiet and price remains about as previously reported. Considerable spot business is now being done, but it is all a "hand to mouth" transaction. *Castor oil* is again stepping up, another one-half cent having been added to the old price of 12¾c. A good volume of business is being done on this item and further advances may come along at any time.

PAINT MATERIALS

This is the dull season between the spring and fall rush and aside from general routine purchasing, very little is going on. Several of the prominent paint grinders are taking advantage of low freight rates on Mississippi barge lines from New Orleans and are having carloads of *ochre* shipped direct from France via New Orleans.

The Iron and Steel Market

PITTSBURGH, July 21, 1922.

The dominant factors in the iron and steel situation are transportation conditions and the coal strike. Following the congestion that began about the middle of June on the railroads serving non-union coal districts in West Virginia and Kentucky came the strike of railroad shopmen July 1, and transportation conditions in many sections are now decidedly poor. Supplies of non-union coal to steel mills and by-product coke plants, particularly in Ohio, Western Pennsylvania and the Buffalo district, are greatly curtailed, while the movement of finished steel products is beginning to grow difficult. Even the movement of scrap is affected in some cases.

This week's developments at Washington in the coal matter make it the present outlook that the national organization of coal miners will be shorn of much of its power but that there will be a long and difficult struggle, during which coal will be scarce and high priced.

DECLINE IN STEEL PRODUCTION

The steel market is a matter of tonnage and price. As to tonnage, production has already decreased slightly, not enough to make much difference at the moment, but enough to show that the rate of production is decreasing, after having increased almost constantly for six months. The sharp increases were in the first three months of the year, with more moderate increases in April and May, followed by a merely perceptible increase in June, the rate in June being about 80 per cent over the rate in December. Since then the rate has decreased slightly, but possibly by as much as 5 per cent. With the present trends, there will be a greater decrease in the next fortnight.

The price of steel is another matter. It requires coal and transportation facilities to consume steel as well as to produce steel, a fact that is occasionally overlooked. Thus far there has been no definite sign that steel consumption is materially reduced, but there are distinct possibilities that it may be.

While the actual rate of steel consumption cannot be scrutinized closely, the attitude of steel buyers can be observed. This attitude has undergone some change. There is somewhat more eagerness to buy prompt lots, not in large quantities but in moderate sized lots, and there is willingness to pay extra prices. Some steel products, such as butt weld pipe, are being bought in carload lots from warehouse at regular warehouse prices, representing a differential over prices for mill deliveries that would be a stupendous advance if written into the mill price. On the other hand, buyers are showing a strong disinclination to commit themselves on purchases for delivery in the late months of the year. The turnover in far-forward deliveries is very light. Very probably the mills would not care to sell freely for such deliveries but the market shows that they do not have the opportunity now, as they did have a few weeks ago.

STEEL AND IRON PRICES

Basis prices are practically unchanged and there is little if any disposition on the part of mills to advance them, evidently by reason of fear that advances would merely invite a reaction later on. Prompt deliveries are higher in some cases, particularly in bars, shapes and plates, which have been going at prices as high as 1.80c. or 1.90c., the basis price, for late delivery, remaining at 1.60c. Sheets are moving less at premium prices than formerly, and some mills formerly demanding a premium for shipment from stock are now offering stock sheets at basis prices, 2.40c. for blue annealed, 3.15c. for black and 4.15c. for galvanized.

The $2.50 price on nails instituted by independents about the middle of April has practically disappeared, the regular market being $2.40; the price the American Steel & Wire Co. has adhered to. Demand is better than usual at this time of year. Wire fence has been stimulated somewhat by the recent reduction of 2½ points.

Pig iron continues dull as to actual turnover. Consumers are not disposed to take hold, despite the prospect that production will decline considerably in the next few weeks on account of coke shortage. The local market is quotable at $25 for Bessemer and $24 for basic and foundry, both basic and foundry being a shade lower than the average market price ruling in May and June. At present, coke prices are far below cost of production.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0.11 – $0.11½	.11½ – .13
Acid, acetic, 28 per cent	100 lbs.	2.35 – 2.50	2.55 – 3.00
Acetic, 56 per cent	100 lbs.	5.00 – 5.25	5.30 – 5.50
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		9.75 – 10.00	10.25 – 10.50
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.	..... –	.44½ – .45
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06½	.06½ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.14½ – .14¾	.15 – .15½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08½ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 – 10.00	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.28½ – .29
Tartaric acid, imported, powdered	lb.	..... –	.29 – .30
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.28 – .31
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.28 – .31
Alum, ammonia, lump	lb.	.03½ – .03¾	.03½ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03¼ – .04
Alum, chrome lump	lb.	.05 – .05½	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg. drums (750 lb.)	lb.	.06½ – .07½	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08 – .08½	.08½ – .09
Ammonium nitrate	lb.	.06 – .06½	.06½ – .07½
Amylacetate tech.	gal.	..... –	2.00 – 2.25
Arsenic, white, powdered	lb.	.08 – .08½	.08½ – .08¾
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	61.00 – 63.00	64.00 – 68.00
Barium chloride	ton	90.00 – 93.00	94.00 – 105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.85 – 2.50
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06½
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2.40	2.45 – 2.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.80 – .83
Carbon bisulphide	lb.	.06½ – .06¾	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.50 – 6.60	6.65 – 7.00
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.07½ – .07¾	.07½ – .08
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth—imported powdered—net	ton	30.00 – 32.00	..... – .....
Fusel oil, ref.	gal.	..... –	2.25 – 2.65
Fusel oil, crude	gal.	..... –	1.45 – 1.50
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.15½ – .15¾
Iodine, resublimed	lb.	..... –	4.20 – 4.25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate	lb.	..... –	.09½ – .11½
Lead arsenate, powd.	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08 – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.10 – .10½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.09½ – .09¾	.10 – .10½
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.05 – .05½	.05½ – .06
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07½ – .08
Potassium cyanide	lb.	..... –	.50 – .52
Potassium hydroxide (caustic p tash)	100 lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.14 – .14½	.14½ – .15
Potassium prussiate, red	lb.	..... –	.90 – .95
Potassium prussiate, yellow	lb.	.31½ – .32	.32½ – .32½
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .07	.07½ – .08
Salammoniac, gray, granular	lb.	.07½ – .08	.08½ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	20.00 – 25.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.06½ – .06¾	.07 – .07½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.06½ – .07	.07½ – .07½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04¾	.04½ – .05½
Sodium chlorate	lb.	.06½ – .06¾	.07 – .07½
Sodium chloride	long ton	12.00 – 13.00	..... – .....
Sodium cyanide	lb.	.21 – .22	.22½ – .25
Sodium fluoride	lb.	.09½ – .10	.10½ – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.55 – 3.60	3.75 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03½	.03½ – .04
Sodium nitrite	lb.	.08 – .08½	.08½ – .09
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.20½ – .21	.21½ – .21½
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04¾	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03¾	.03½ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 – 20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 – 40.00	..... – .....
Talc—domestic powdered	ton	18.00 – 25.00	..... – .....
Tin bichloride	lb.	.09 – .09½	.09½ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14½ – .15½
Zinc chloride, gran.	lb.	.06 – .06½	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08½ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.14 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.50 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.59 — .65
H-acid	lb.	.85 — .95
Meta-phenylenediamine	lb.	.95 — 1.00
Monochlorbenzene	lb.	.09 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.15 —	1.30
Ortho-amidophenol	lb.	2.40 —	2.50
Ortho-dichlor-benzene	lb.	2.15 —	.20
Ortho-nitro-phenol	lb.	.70 —	.75
Ortho-nitro-toluene	lb.	$0.13 —	$0.13
Ortho-toluidine	lb.	.14 —	.18
Para-amidophenol, base	lb.	1.25 —	1.30
Para-amidophenol, HCl	lb.	1.30 —	1.35
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.75 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.90 —	1.00
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.15 —	.15½
Pyridine	gal.	1.75 —	2.75
Resorcinol, technical	lb.	1.30 —	1.35
Resorcinol, pure	lb.	1.75 —	1.80
R-salt	lb.	.60 —	.70
Salicylic acid, tech., in bbls	lb.	.25 —	.25½
Salicylic acid, U. S. P	lb.	.26 —	.26½
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 —	.32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.14 —	.18
Sulphanilic acid, crude	lb.	.24 —	.26
Toluidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.25 —	.28
Toluene, in drums	gal.	.30 —	.35
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.40 —	.45
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.33 —	.35
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

All prices remain same as previous report

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$5.55 —	$5.95
Rosin E-I	280 lb.	6.00 —	6.45
Rosin K-N	280 lb.	6.55 —	7.65
Rosin W. G.-W. W	280 lb.	7.75 —	8.30
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.22 —	1.23
Wood turpentine, steam dist	gal.	.85 —	....
Wood turpentine, dest. dist	gal.	.70 —	.70
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	9.50
Retort tar, bbl	500 lb.	—	9.00
Rosin oil, first run	gal.	.36 —	....
Rosin oil, second run	gal.	.38 —	....
Rosin oil, third run	gal.	.46 —	....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr.1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
Blood, dried, f.o.b., N. Y	unit	4.50 —	....
Bone, 3 and 50, ground, raw	ton	37.00 —	39.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.60 —	2.65
Tankage, high grade, f.o.b. Chicago	unit	3.50 —	3.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	4.00 —	4.50
Tennessee, 78-80%	ton	8.00 —	8.50
Potassium muriate, 80%	ton	33.50 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0.19 —	.19½
Upriver coarse	lb.	.13½ —	.13½
Upriver caucho ball	lb.	.13 —	.13½
Plantation—First latex crepe	lb.	.14½ —	.15
Ribbed smoked sheets	lb.	.14½ —	.15
Brown crepe, thin, clean	lb.	.13½ —	....
Amber crepe No. 1	lb.	.14 —	....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.11 —	$0.11½
Castor oil, AA, in bbls	lb.	.12 —	.12½
China wood oil, in bbls	lb.	.12½ —	.12½
Coconut oil, Ceylon grade, in bbls	lb.	.08½ —	.08½
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09½
Corn oil, crude, in bbls	lb.	.11 —	.11½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½ —	.08½
Cottonseed oil, summer yellow	lb.	.10½ —	.11
Cottonseed oil, winter yellow	lb.	.11½ —	.12
Linseed oil, raw, car lots (domestic)	gal.	.89 —	.90
Linseed oil, raw, tank cars (domestic)	gal.	.84 —	.85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.92 —	.93
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07 —	.07½
Palm, Niger	lb.	.06½ —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09½ —	.09½
Peanut oil, refined, in bbls	lb.	.12½ —	.12½
Rapeseed oil, refined in bbls	gal.	.82 —	.83
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.12 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09½ —	....

FISH

Light pressed menhaden	gal.	$0.51 —	....
Yellow bleached menhaden	gal.	.53 —	.54
White bleached menhaden	gal.	.55 —	.56
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1, crude, tanks, coast	gal.	45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700.00	$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	75.00	—110.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00	— 17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00	— 23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	— 21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	— 24.00
Barytes, crude f.o.b. mines	net ton	8.00	— 9.00
Casein	lb.	.10½	— .13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	— 8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	— 9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	— 20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00	— 20.00
China clay (kaolin), imported, lump	net ton	16.00	— 20.00
China clay (kaolin), imported, powdered	net ton	30.00	— 35.00
Feldspar, No. 1 pottery grade	long ton	4.50	— 6.75
Feldspar, No. 2 pottery grade	long ton	5.75	— 5.90
Feldspar, No. 1 soap grade	long ton	7.00	— 7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00	— 22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05	— .05½
Graphite, Ceylon chip	lb.	.04	— .04½
Graphite, high grade amorphous crude	ton	35.00	— 50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	— ....
Kieselguhr, f.o.b. N. Y	per ton	50.00	— 55.00
Magnesite, calcined (powdered)	per ton	8.00	— 12.00
Pumice stone, imported	lb.	.03	— .05
Pumice stone, domestic, lump	lb.	.05	— .05½
Pumice stone, domestic, ground	lb.	.06	— .07
Shellac, orange fine	lb.	.81	— .82
Shellac, orange superfine	lb.	.83	— .84
Shellac, A. C. garnet	lb.	.68	— .69
Shellac, T. N.	lb.	.79	— .80
Silica, glass sand, f.o.b. Indiana	per ton	1.50	— 2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50	— 5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00	— 16.00
Silica, building sand, f.o.b. Pa	per ton	2.00	— 2.75
Soapstone	ton	12.00	— 15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00	— 12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50	— 12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16.00	— 20.00

Refractories

Quotations Remain Same as Previous Report

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
Ferromanganese, 78-82% Mn, German	gross ton	67.00 —	67.50
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58.00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V	lb.	3.50 —	4.00

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent	18.00–19.00
Antimony, wholesale lots, Chinese and Japanese	5.00
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	31.625
Lead, New York, spot	5.65– 5.75
Lead, E. St. Louis, spot	5.375– 5.40
Zinc, spot, New York	6.10 – 6.15
Zinc, spot, E. St. Louis	5.75 – 5 80

OTHER METALS

Silver (commercial)	oz.	$0.70½	
Cadmium	lb.	1.20–1.25	
Bismuth (500 lb. lots)	lb.	2.00@2.10	
Cobalt	lb.	3.00@3.25	
Magnesium, ingots, 99 per cent	lb.	1.10	
Platinum	oz.	90.00	
Iridium	oz.	170.00@175.00	
Palladium	oz.	55.00@ 60.00	
Mercury	75 lb.	55.00	

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The Benson Paint & Varnish Co., 2317 1st Ave. recently organized with a capital of $50,000, is planning for the installation of additional equipment for the manufacture of its regular line of paint products. K. Y. Benson is president.

MONTGOMERY—The American Cotton Oil Co. has preliminary plans in progress for the construction of a new building at its plant on Decatur St., near Pollard St., estimated to cost about $13,000.

MOBILE—The Fish Products Corp., recently organized with a capital of $50,000, has acquired property on the Bayou la Batre as a site for the erection of a new plant for the manufacture of fertilizer products. The initial works will be equipped for a capacity of about 10 tons of commercial fertilizer daily. The company is headed by W. B. Jones, Biloxi, Miss., and John E. Rolston, Coden, Ala.

California

SANTA PAULA—The Standard Oil Co. of California, San Francisco, has plans under way for the construction of a new oil distributing plant. A local site has been acquired. The plant will consist of a number of 1-story buildings.

PITTSBURG—Following a merger of the Columbia Steel Co., Market St., San Francisco, and the Utah Coal & Coke Co., operating in Carbon and Iron Counties, Utah, the new company, to be known as the Columbia Steel Corp., capitalized at $15,000,000, has extensive plans under way for expansion. It is proposed to enlarge the present mill at Pittsburg as well as the steel foundry at this location; the Utah properties will also be developed. The work is estimated to cost in excess of $1,500,000.

SAN LUIS OBISPO—The Associated Oil Co. has commenced the construction of a new distributing and industrial plant on the Islay Road. It will consist of a number of 1-story buildings, with tanks, etc., estimated to cost about $35,000.

LOS ANGELES—Kay & Brunner, 2714 Frederick St., operating a foundry, have filed plans for the erection of a new 1-story addition.

Connecticut

HARTFORD—The Capital Glass Co., 14 Chapel St., has filed plans and commenced the erection of a new addition, estimated to cost about $29,000.

Florida

DAYTONA—A new company is being organized by L. E. and L. N. Treadaway, Daytona, to construct and operate a local plant for the manufacture of insect powders and other chemical specialties. The company will be capitalized at $85,000 and it is said that the new plant will cost close to $40,000, including equipment.

Indiana

EVANSVILLE—The Southern Indiana Gas & Electric Co. has commenced the construction of a new gas-retort building, in connection with a number of gas plant improvements, estimated to cost close to $500,000.

EVANSVILLE—William S. Baerich and associates have acquired the local plant of the Stronghold Tire & Rubber Co., from the receiver. The factory was commenced a number of months ago but was never completed. The new owners are said to be planning to reorganize the company, finish the plant erection, and install equipment for the manufacture of tires and other rubber goods.

Illinois

JOLIET—The Standard Wall Paper Co., Hudson Falls, N. Y., has awarded a contract to the Austin Co., 208 South LaSalle St., Chicago, for the construction of a new 1-story plant on East Washington St., 60x100 ft., estimated to cost approximately $75,000, including equipment. Winfield A. Huppuch is president.

GRANITE CITY—The National Enameling & Stamping Co., 411 5th Ave., New York, N. Y., manufacturer of enameled ware, has plans nearing completion for the construction of an addition to its local plant, comprising 6 new buildings, estimated to cost approximately $1,500,000, including equipment. George W. Niedrinhous is president.

EAST ST. LOUIS—The Obear-Nester Glass Co., 25 North 2nd St., St. Louis, Mo., has commenced the construction of its proposed new local plant at Broadway and 22nd St., to be 1-story, 150x230 ft. and estimated to cost about $40,000. The company specializes in the manufacture of glass bottles and containers.

CHICAGO—The Chicago Butchers' Calf Skin Association, 3208 South Robey St., is taking bids and will soon award contract for the construction of a 3-story addition to its fertilizer manufacturing plant at location noted, 24x140 ft., estimated to cost about $50,000. H. C. Christensen, 7258 Union Ave., is architect. William Haffel is president.

ROCKFORD—The Rockford Malleable Iron Works, Inc., has awarded a contract to The Austin Co., 208 South LaSalle St., Chicago, for the construction of a new 1-story foundry, 150x200 ft., estimated to cost about $125,000, including machinery.

Kentucky

ASHLAND—The Indian Refining Co., 27th St. and Greenup Ave., has preliminary plans under way for the construction of an addition to its local oil plant, to consist of a number of 1-story buildings.

LOUISVILLE—The Peaslee, Gaulbert Co., 413 Main St., manufacturer of varnishes, wood finishes, etc., has commenced excavations for its proposed plant addition at 15th and Lytle Sts., to be 1-, 2- and 3-story, estimated to cost about $100,000, including equipment. Alterations and improvements will be made also in the present factory. D. X. Murphy & Brothers, Louisville Trust Bldg., are architects.

Maryland

BALTIMORE—The Board of Directors, Johns Hopkins University, has plans nearing completion for the construction of a 4-story chemical laboratory at the institution, 200x200 ft., estimated to cost about $500,000. Carrere & Hastings, 52 Vanderbilt Ave., New York, N. Y., are architects; Charles L. Reeder, 916 North Charles St., Baltimore, is engineer.

BALTIMORE—The Oil Products Co., 304 North Holiday St., manufacturer of lubricating oils, greases, and chemical specialties, recently reorganized with a capital of $35,000, has plans under way for enlargements in its 3-story plant for considerable increase in capacity. J. G. Platt is president; A. L. Kibler is vice-president and chemical director.

BALTIMORE—A 1-story foundry, estimated to cost about $25,000, will be constructed at the new plant of the Republic Boiler & Radiator Co., Union Ave, Woodberry district.

HAGERSTOWN—The Security Cement & Lime Co. plans for the installation of a new tube mill at its plant. Inquiries are out for used equipment in first class condition.

Michigan

DEARBORN—The Ford Motor Co., Highland Park, Mich., has plans under way for the construction of a 1-story laboratory building on local site, 200x800 ft. estimated to cost approximately $500,000, including equipment. It will be used for steel and steel alloy testing, and other general laboratory service.

Minnesota

CLOQUET—The Northwestern Paper Co. has awarded a contract to Siems, Helmers & Schaffner, Inc., 514 Guardian Life Bldg., St. Paul, Minn., for the construction of a 2-story sulphite pulp mill, 200x500 ft., to cost close to $500,000, including machinery. George F. Hardy, 209 Broadway, New York, N. Y., is engineer.

Missouri

JOPLIN—The Wilhoit Refining Co. has plans under way for extensions and improvements in its local oil refinery to cost about $75,000.

New Jersey

BAYONNE—The International Nickel Co., Oak and Hobart Aves., has filed plans for the construction of an addition to its local plant to cost about $15,000.

New York

PEEKSKILL—Fire, July 11, destroyed two of the buildings at the local plant of the Fleischmann Yeast Co., with loss estimated at about $125,000, including equipment. It is said that the plant will be rebuilt. Headquarters of the company are at 701 Washington St., New York, N. Y.

North Carolina

NEWTON—The Newton Oil & Fertilizer Mill, Inc., has preliminary plans under consideration for the construction of a new local plant for the manufacture of commercial fertilizers. S. D. Hauk is head.

FOREST CITY—The Forest City Oil Mill Co., manufacturer of cotton-seed oils, has plans nearing completion for the construction of a new local plant, estimated to cost about $90,000. Of this amount, approximately $65,000 will be expended for equipment.

Ohio

AKRON—The American Vitrified Products Co. has filed plans and will commence the immediate erection of an addition to its plant to replace a structure recently destroyed by fire.

AKRON—The Firestone Tire & Rubber Co. will soon commence the installation of equipment in a new building at its plant completed a number of months ago and heretofore unoccupied. It will be used for the manufacture of steel specialties, including rims etc., for automobile tires.

BARBERTON—The Lambert Tire & Rubber Co. will install equipment at once at its plant, to double the present capacity.

Oklahoma

OKLAHOMA CITY—The Apco Refining Co., Colcord Bldg., recently incorporated with a capital of $100,000, has selected a local site and has plans in preparation for the construction of a new oil refining plant with initial output of about 1,200 bbl. per day.

PONCA CITY—The 101 Ranch Co. is reported to be planning for the rebuilding of its tanning plant, including power house, destroyed by fire July 6, with loss estimated at about $50,000, including equipment.

Pennsylvania

STROUDSBURG—Fire, July 14, destroyed the plant of the Nitroloid Corp., manufacturer of celluloid and other composition products, with loss estimated at about $250,000 including equipment. It is said that the plant will be rebuilt.

JACOBS CREEK—The U. S. A. Drug & Chemical Co., Jacobs Creek, has plans under way for the construction of a new 3-story plant on local site, 72x125 ft., estimated to cost about $150,000, including equipment. Peter R. Rossello 406 Congress Bldg., Detroit, Mich., is architect.

READING—Orr & Sembower, Inc., Millmont, near Reading, operating a metal-working plant, is planning for the rebuilding of the portion of its brass foundry, recently destroyed by fire. The estimated loss has not been announced.

PHILADELPHIA—E. I. duPont de Nemours & Co., manufacturers of paints, varnishes, etc., have filed plans for the construction of a 1-story addition to their local plant at 3500 Grays Ferry Road, estimated to cost about $15,000.

PITTSBURGH—E. A. Campbell has acquired the plant and equipment of the Eagel Paint & Varnish Co., Galveston Ave., from Elliott Frederick, trustee. The plant is located on a site 150x270 ft., and was secured for a consideration said to be $51,170. The new owner is said to be arranging for a reorganization of the company and the continuance of the plant in operation.

PHILIPSBURG—Thomas J. Lee and associates are perfecting arrangements for a reorganization of the Nickel Fabricating Co. and the operation of the local plant recently acquired under bankruptcy pro-

ceedings. The plant has been idle for about six months past. The new company will make repairs and improvements to the equipment and plan to place the works in service at an early date.

Tennessee

CHATTANOOGA—The Scholze Soap & Fertilizer Co., recently organized with a capital of $150,000, has preliminary plans under way for the construction of a new plant on local site for the manufacture of soap products. It is estimated to cost about $100,000, including machinery. Henry Scholze and J. N. Kline, head the company.

Texas

DALLAS—E. L. Flippen, heretofore vice-president of the Planters' Cotton Oil Co., and Hugh E. Prather have acquired the local plant of the company, under bankruptcy proceedings, for a consideration of $99,000. The mill is located in the Breezy Hill section and was constructed a number of years ago, at a cost said to be $400,000. The new owners will reorganize the company and will make extensions and improvements to the plant. It is expected to have the mill ready for production early in the fall.

SAN ANTONIO—The Ideal Mfg. Co., recently organized, has plans in preparation for the construction of a 1-story plant on local site, 60x175 ft. for the manufacture of polishes, enamels, etc. E. D. Nolan is treasurer.

CROSS PLAINS—The Bristow Refining Co. is completing the construction of the first unit of its new local oil refining plant, and plans to place the mill in service at an early date. It will have a capacity of about 500 bbl. per day. It is proposed to construct additional plant units in the near future.

Virginia

RICHMOND—The Fish Guano Co. has acquired property at Fulton, near Richmond, and plans for the constructon of a new 1-story plant, 105x200 ft., for the manufacture of fertilizer products. It will have an initial capacity of about 25,000 tons of material per annum, and is estimated to cost about $55,000, with machinery. Walter C. Hill is president.

West Virginia

WHEELING—The Wheeling Oxygen Co., 1130 Market St. has commissioned the Industrial Engineering Co., Park Bldg., Pittsburgh, Pa., to prepare plans for the construction of a new plant on 16th St., Warwood, near Wheeling. It will be used for the manufacture of commercial oxygen, and is estimated to cost in excess of $50,000.

SHINNSTON—The Alley Glass Co., recently organized, has acquired a local building for the establishment of a new plant for the manufacture of cut glass products. L. E. Alley is president and general manager; Paul E. Tetrick is treasurer.

LUMBERPORT—The Mound City Glass Co. has commenced the construction of a new finishing department at its plant and will make other extensions and improvements to double, approximately, the present capacity. It is proposed to increase the working force by about 150 men upon completion.

Canada

NEW WESTMINISTER, B. C.—The Westminster Paper Co., affiliated with the Interlake Tissue Paper Co., Merritton, Ont., has preliminary plants in progress for the construction of a new mill on the Frazier River for the manufacture of tissue and other light-weight papers. It is said that the plant will cost in excess of $200,000.

MONTREAL, QUE.—The British Empire Steel Corp. is reported to be planning for the construction of a new steel mill, to cost in excess of $10,000,000. The work will comprise new open hearth furnaces, blooming mills, as well as improvements to present blast furnaces. A number of buildings at the present works will also be remodeled and improved, and new equipment installed.

New Publications and Books

"The Future Independence and Progress of American Medicine in the Age of Chemistry." A report by John J. Abel, Carl L. Alsberg, Raymond F. Bacon, F. R. Eldred, Reid Hunt, Treat B. Johnson, Julius Stieglitz, F. O. Taylor and Charles H. Herty. Published by the Chemical Foundation, New York.

Beiträge zu Einer Kolloidchemie des Lebens (Biologische Diffusionen). By Dr. Raphael Ed. Liesegang. Published by Verlag von Theodor Steinkopff, Dresden and Leipzig, Germany.

The Imperial Mineral Resources Bureau, London, England, has issued pamphlets on gold, copper, tin and platinum and allied metals. All of these are for the war period from 1913 to 1919.

The Department of Scientific and Industrial Research, London, has issued Bulletin No. 6 on the Electrodeposition of Iron. By W. E. Hughes.

The University of Illinois has issued Bulletin No. 128, on "The Ignition Temperature of Coal," by Ray W. Arms, and Bulletin No. 129, on "An Investigation of the Properties of Chilled Iron Car Wheels," by J. M. Snodgrass and F. H. Guldner.

The U. S. Department of Agriculture has issued Bulletin No. 983, on "The Manufacture of Ethyl Alcohol From Wood Waste," by F. W. Kressmann, and Bulletin No. 1057, on "The Chaulmoogra Tree and Some Related Species," by Joseph F. Rock.

The Scientific and Industrial Research Council of Alberta has issued its second annual report.

The Bureau of Foreign and Domestic Commerce has issued Trade Information Bulletin No. 11, "The Steel-Making Facilities of Great Britain" by H. B. Allin Smith and Trade Information Bulletin No. 31, on "Markets for Chemicals in the Netherlands, East Indies and British Malaya" by John A. Fowler.

New U. S. Geological Survey Bulletins: "Some Field Tests and an Assay of Texas Potash Salts" by George Steiger. This mimeographed report can be obtained on application to the Survey office in Washington. The methods described are for identification and analysis of the mineral salts with special reference to the examination of the types of mineral found in the western Texas fields. The instruction for field methods are given in elementary form so that those with little or no previous training in chemistry will be able to carry them out. Other bulletins are I: 1, "Cadmium in 1921," by C. E. Siebenthal and A. Stoll (Mineral Resources of the U. S., 1921, Part 1) published April 10, 1922; I: 2, "Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1921." by J. P. Dunlop (Mineral Resources of the U. S., 1921, Part I) published May 12, 1922; I: 23, "Quicksilver in 1920," by F. L. Ransome, with a supplementary bibliography by Isabel P. Evans (Mineral Resources of the U. S., 1920, Part I) published March 27, 1922; I: 25, "Lead and Zinc Pigments and Salts in 1920," by C. E. Siebenthal and A. Stoll (Mineral Resources of the U. S., 1920, Part I) published April 26, 1922; I: 26, "Copper in 1920" (General Report) by H. A. C. Jenison (Mineral Resources of the U. S., 1920, Part I) published May, 16, 1922; II: 2, "Graphite in 1921," by L. M. Beach (Mineral Resources of the U. S., 1921, Part II) published June 5, 1922; II: 3, "Peat in 1921," by K. W. Cottrell (Mineral Resources of the U. S., 1921, Part II) published June 6, 1922; II: 29, "Mica in 1920," by B. H. Stoddard (Mineral Resources of the U. S., 1920, Part II) published April 12, 1922.

New Bureau of Mines publications: Bulletin 200, "Evaporation Loss of Petroleum in the Mid-Continent Field," by J. H. Wiggins; Bulletin 207, "The Analytical Distillation of Petroleum and Its Products," by E. W. Dean, H. H. Hill, N. A. C. Smith and W. A. Jacobs; Tech. Paper 258, "Production of Gasoline by Cracking Heavier Oils," by E. W. Dean and W. A. Jacobs; Tech. Paper 263, "Design and Operation of a Low-Pressure Absorption Plant," by W. P. Dykema and A. A. Chenoweth; Tech. Paper 268, "Preparation and Uses of Tar and Its Simple Crude Derivatives," by W. W. Odell; Tech. Paper 298, "Methods for Testing Petroleum Products;" Tech. Paper 305, "Specifications for Petroleum Products adopted by the Interdepartmental Petroleum Specifications Committee."

New Bureau of Standards publications: Scien. Paper No. 432, "An Improved Method for Preparing Raffinose," by E. P. Clark; Scien. Paper 433, "Thermal Expansion of a Few Steels," by Wilmer Souder and Peter Hidnert; Scien. Paper 434, "Electromotive Force of Cells at Low Temperatures," by G. W. Vinal and F. W. Altrup; Scien. Paper 435, "Metallographic Etching Reagents," by Henry S. Rawdon and Marjorie C. Lorentz; Scien. Paper 436, "Interference Methods for Standardizing and Testing Precision Gage Blocks," by C. G. Peters and H. S. Boyd; Scien. Paper 437, "The Solubility of Dextrose in Water," by Richard F. Jackson and Clara Gillis Silsbee; Tech. Paper 210, "The Redwood Viscosimeter," by Winslow H. Herschel.

The smoke investigation of the Mellon Institute has Bulletin No. 10 in press. This publication, which is entitled "Recent Progress in Smoke Abatement and Fuel Technology in England," presents the results of an investigation by Robert J. McKay, an industrial fellow of the Institute.

BOOKS

AMERICAN RESEARCH CHEMICALS. By *Clarence J. West*. National Research Council, Reprint and Circular Series No. 35, pp. 37. Price, 5oc. The research chemist and the purchasing agent in search of unusual and comparatively unknown chemical compounds will find this compilation extremely valuable. The pamphlet is the report of the Council's committee on research chemicals, of which W. D. Collins is chairman and C. J. West secretary. The subject matter is divided into four parts, viz.: A list of the 80 manufacturers of fine chemicals, the names of approximately 1,800 research chemicals with numerical reference to their manufacturers, 500 biological stains, indicators and their makers' numbers and finally, the principal hydrogen-ion indicators, the index number of the firms making them and a chart showing their *pH* ranges.

MEXICAN YEAR BOOK, 1920-1921. By *Robert Glass Cleland, Ph.D.* Los Angeles: Mexican Year Book Publishing Co., cloth, 6x9 in.; pp. 524. Price, $7.50. Americans desirous of unbiased and systematized information concerning Mexico will find this book unusual in that it has no official Mexican patronage. In addition to authoritative chapters on geography, transportation, commerce, natural resources, etc., the book contains an appendix of practical suggestions for business travelers in Mexico and gives details concerning postal and tariff regulations, the recent colonization decree and the treaties now in force between Mexico and the United States. It also contains a bibliography of works on Mexico. Three maps show the political divisions, principal cities, lines of communication, mining centers and the Panuco-Tuxpam oil fields.

WORLD METRIC STANDARDIZATIONS AN URGENT ISSUE. Compiled by *Aubrey Drury* and collaborators. Published by World Metric Standardization Council, San Francisco, Cal. 524 pp. Price $5. Herbert Hoover is responsible for the statement: "Standardization is an outstanding necessity in the mind of every engineer desirous of the advance of industry and commerce. There is no field where more constructive work can be accomplished in this direction of national efficiency of the whole gamut of production and distribution than in the field of standards." Engineers who are willing to accept this generalization of Secretary Hoover will find much of interest in Mr. Drury's exhaustive compilation, for this volume deals with the "master standards" of the world—the three metric units—meter, liter, gram. The book urges that the units of weights and measures of the United States and the British commonwealths be brought into accord with these invariable standards, for when this advance is achieved, practically the entire world will be upon the uniform metric basis. The compilation of this book is the result of a number of years of intensive study. Over 30,000 letters and papers on the metric movement had been gathered into the files of the World Standardization Council and in addition the compilers drew largely on material in the files of the American Metric Association, the British Decimal Association and a number of other such organizations. The work is a valuable storehouse of information to all who are interested in the progress of metric standardization.

"SUMMARY OF TARIFF INFORMATION, 1921" is the title of a 1,600-page volume just issued by the Tariff Commission, Washington, D. C. Copies may be obtained from the Superintendent of Documents, Government Printing Office, at $1.25.

"DUST EXPLOSIONS" is the title of a new book, by *David J. Price* and *Harold H. Brown*, assisted by *Hylton R. Brown* and *Harry E. Roethe*, just published by the National Fire Protection Association, Boston, Mass., with permission of the U. S. Department of Agriculture. Price, $3. The book contains the results of the dust explosion investigations of the Bureau of Chemistry, U. S. Department of Agriculture and should be of value in the prevention of dust explosions and the reduction of losses to life, foodstuffs and property in the industrial plants of the United States and Canada.

ELEKTRISCHE BEHANDLUNG VON GASEN. By *Henri Silbermann*. Published by Dr. Max Jänecke Verlagsbuchhandlung, Leipzig, Germany.

New Companies

THE TURLINGTON CHEMICAL CO., 339 Equitable Bldg., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical by-products, soaps, etc. The incorporators are Randall A. Turlington, Philander B. Briscoe and Willis R. Jones.

THE COLREX MFG. CO., New York, care of C. E. Toney, 184 West 135th St., representative, has been incorporated with a capital of $25,000, to manufacture polishes and kindred specialties. The incorporators are J. E. Blackwell, D. and J. C. Doles.

THE RELIANCE TILE & FAIENCE CO., Perth Amboy, N. J., has been incorporated with a capital of $300,000, to manufacture tiles, ceramics, and kindred products. The incorporators are Fred Keck, George J. Janovsik and N. F. Herron, 107 Fayette Street, Perth Amboy.

THE NEHOIDEN OIL CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture refined oil products. M. William Lawlor is president and James Keltie, 83 Warren Street, Needham, Mass., treasurer.

THE SUPERIOR CHEMICAL PRODUCTS CORP., 303 West Chicago Ave., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical by-products. The incorporators are Douglas G. Logan, H. J. Logan and Claude H. Pratt.

THE UNIVERSAL PAPER GOODS CO., Los Angeles, Cal., care of Kimpton Ellis, 626 Washington Bldg., representative, has been incorporated with a capital of $20,000, to manufacture paper specialties. The incorporators are G. R. Allenson, L. E. Bartels and H. D. Allenson, all of Los Angeles.

THE BURNOT FIREPROOFING PRODUCTS OF BALTIMORE, INC., 207 West Calvert St., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture fireproof paints and other kindred fireproofing products. The incorporators are William R. Semans, Henry L. D. Standford, Jr. and F. Fulton Bramble.

THE GREAT EASTERN GALENA SILVER, LEAD & ZINC CO., Pottsville, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa., representative, has been incorporated under Delaware laws with a capital of $400,000, to operate zinc, lead and other metal refining plants and properties. The incorporators are Miles E. Reinhart, Palmerton, Pa.; Jacob Brewer, Hazleton, Pa., and C. Crossman, Pottsville.

THE BATWAY COLOR WORKS, INC., 36 East State St., Trenton, N. J., has been incorporated with a capital of 5,000 shares of stock, no par value, to manufacture colors, chemicals, etc. The incorporators are Edward C. Georges, Louis F. Menage and William Campbell.

THE ACOMA CHEMICAL CO., Clayton, Mo., has been incorporated with a capital of $15,000, to manufacture chemicals and chemical byproducts. The incorporators are Moses Leon, J. F. L. and B. M. Zingre, all of Clayton.

THE BRANFORD BRASS FOUNDRY, INC., Branford, Conn., has been incorporated with a capital of $50,000, to manufacture brass, bronze and other metal castings. The incorporators are F. A. Ellis, H. A. Cox and A. V. Neilson, all of Branford.

THE STEVENS & THOMPSON PAPER CO., North Hoosick, N. Y., has been incorporated with a capital of $1,500,000, to manufacture paper products. The company will comprise a consolidation of the Stevens & Thompson Co., and the Walloomsac Paper Co. Frank L. Stevens, North Hoosick, is the principal incorporator and represents the company.

THE NUEVA OIL CO., Laredo, Tex., has been incorporated with a capital of $40,000, to manufacture petroleum products. The incorporators are O. W. and W. T. Killam, and R. F. Peck, all of Laredo.

THE METROPOLITAN PETROLEUM CO., Long Beach, Cal., has been incorporated with a capital of $200,000, to manufacture petroleum products. The incorporators are Albert Stephens, Claude C. Sumter and F. E. Lewis, all of Long Beach.

Following the acquisition of the Carpenter Steel Co., Reading, Pa., by the Penn Seaboard Steel Corp., Philadelphia, Pa., operations have been increased from 35 to 40 per cent of capacity. The wage schedule of employees has been advanced, those earning 24 cents per hour and under receiving a 3- to 5-cent hourly increase, and proportionate advance to workers earning more.

THE CENTRAL IRON & STEEL CO., Harrisburg, Pa., is planning for the resumption of full operations at its mills in the near future. The plant is now running at close to 75 per cent of normal.

THE ALABAMA IRON & STEEL CO., Gadsden, Ala., is making repairs to the second furnace at its local plant, and is said to be planning to place the unit in blast in the near future.

THE ANDERSON-PRICHARD OIL CORP., Oklahoma City, Okla., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are L. H. and L. M. Prichard and J. Steve Anderson, all of Oklahoma City.

THE PRESTON CLAY CO., Canton, Ohio, has been incorporated with a capital of $2,000, nominal, to manufacture burned clay products. The incorporators are H. S. Preston and H. S. Williams, both of Canton.

THE STANDARD CASTINGS CO., South Bend, Ind., has been incorporated with a capital of $200,000, to manufacture iron, steel and other metal castings. The incorporators are John N. and Charles L. Zigler, and Richard A. Oglesby, all of South Bend.

THE BRICK & TILE CO., Egg Harbor City, N. J., has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. The incorporators are C. A. Lunneman, John R. O'Neill and Alvin P. Risley, all of Egg Harbor City. The last noted represents the company.

MAX SEE & CO., INC., New York, N. Y., care of Littau & Seligson, 277 Broadway, representatives, has been incorporated with a capital of $10,000, to manufacture leather specialties. The incorporators are Max See and R. Mayer.

THE PRIMO PRODUCTS CO., Worcester, Mass., has been incorporated with a capital of $25,000, to manufacture paints, oils, etc. Irving S. Balcom is president and Henry K. Braetter, 73 Wellington Street, Worcester, treasurer.

Industrial Developments

OIL—The Catlin Shale-Oil Products Co., Elko, Nev., is developing a production of about 40,000 gal. of crude oil daily at its local refinery. A byproducts plant is operated for the recovery of gasoline, paraffine wax, lubricating oils, etc.

The Skelly Oil Co., Tulsa, Okla, is increasing production at its oil refineries to a point of about 11,000 bbl. daily. The gasoline plants of the company are running on a basis of about 25,000 gal. of gasoline daily, and this capacity will be advanced to 40,000 gal. at an early date.

IRON AND STEEL—The Illinois Steel Co., Gary, Ind., is now operating on a basis of about 85 per cent of capacity.

The Lebanon Iron Co., Duncannon, Pa., has reopened its local plant, following a suspension since 1920. Employment will be given to about 150 men, and this quota will be increased at an early date.

A total of 21 blast furnaces are now in operation in the Alabama iron districts, 8 of which are running on basic material and 13 on foundry pig. The different operating plants are: Tennessee Coal, Iron & Railroad Co., Birmingham, 8 furnaces; Sloss-Sheffield Steel & Iron Co., Birmingham, 5 furnaces; Woodward Iron Co., Woodward, 4 furnaces; Republic Steel Co., Birmingham, 2 furnaces; Alabama Iron & Steel Co., Gadsden, 1 furnace; and the Gulf States Steel Co., Alabama City, 1 furnace.

The Central Coal & Iron Co., Holt, Ala., is completing repairs to its local furnace and plans to place the unit in blast at an early date.

The Inland Steel Co., Indiana Harbar, Ind., is now operating at about 65 per cent of capacity.

The Central Iron & Steel Co., Harrisburg, Pa. is making additions to its working force and has advanced production in a number of departments.

The Bethlehem Steel Co. is said to be planning for the early resumption of full time production at its works at Steelton, Pa. The plant is now running on a basis of about 70 per cent of capacity.

The Ohio Falls Iron Co., New Albany, Ind., has placed its local plant on a double-shift basis of operation, giving employment to an increased number of men. The plant has been running full, on single shift schedule, for about 60 days past. The wages of laborers have been advanced 25 cents a day, making a rate of $2.50 a day.

Following a short shut-down for repairs, the Reading Iron Co., has resumed operations at its puddle mill at Danville, Pa. Wages have been increased at the plant, puddlers now receiving $7.50 a ton, instead of $6.50, as heretofore. The company is running full at its 9th St. mill at Reading, Pa.

The United States Steel Corp., Pittsburgh, is now operating on a basis of 75 per cent of capacity at its different mills, considered collectively.

The United States Cast Iron & Pipe Foundry Co. is running at maximum capacity at its plants at Burlington, N. J., and Scottsdale, Pa. Production will soon be advanced at the different plants units of the company in the south.

The Carnegie Steel Co. has resumed operations at the skelp mill at its Farrell, Pa., works, placing the plant on a full 100 per cent basis for the first time in about 2 years.

TIN PLATE—The Follansbee Brothers Co., Pittsburgh, Pa., has resumed operations at its tinplate mills at Follansbee, W. Va., and Toronto, O., giving employment to about 2,500 operatives, both plants.

METALS—The Golden Rod Mining & Smelting Co., Cardin, Okla., has resumed operations at its Mill No. 7, which has been closed down for about a year past. The plant will run on a schedule of 1,000 tons a day.

The New Cornelia Copper Co., Boston, Mass., operating properties in Arizona, is increasing production at its plant and expects to develop an output of about 4,000,000 lb. early in August, as against a production of about 1,500,000 lb. during recent weeks. Plans are under way for the construction of a new flotation mill at the properties, with capacity of about 5,000 tons.

MISCELLANEOUS—The Davison Chemical Co., Baltimore, Md., is increasing operations in its acid phosphate department at the local plant. The company reports a marked increase in orders for agricultural chemicals and expects advance production in this line at an early date. The factory is now operating on a basis of about two-thirds capacity.

The Barrett Mfg. Co. is arranging for the immediate resumption of operations at its paper mills at Kingston, Pa. A working force is being recruited.

The Dixie Consolidated Co., Birmingham, Ala., has placed its Pocohontas, Ala., graphite mill on a full capacity basis, giving employment to regular working force.

All cement mills in the Lehigh Valley section of Pennsylvania are now running at full capacity, with normal force of operatives. Continuous operation is planned for an indefinite period.

The McGraw Tire & Rubber Co., East Palestine, Ohio, is advancing production at its local mill. A schedule of 2,300 casings and an equal number of tubes per day has been arranged. The plant is giving employment to about 600 operatives.

The Thomas Maddock's Sons Co., Trenton, N. J., manufacturer of sanitary ware, has developed production to maximum capacity, with regular working force, and expects to continue on this basis for an indefinite period.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold a summer excursion meeting to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo, Aug. 13-19.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

THE SOCIETY OF INDUSTRIAL ENGINEERS will hold its next national convention and exhibitions of labor-saving equipment at the Hotel McAlpin, New York, Oct. 18, 19 and 20.